

BRAIDING AND
BRAIDING MACHINERY

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FOREWORD

This monograph by W. A. Douglass will fill a gap in the list of books dealing with industrial machines and processes.

BRAIDING is an ancient art (the village Maypole was a braider) developed to handle every kind of thread-material from textile to metallic and makes an indispensable contribution to the needs of modern life.

Braiding is the basic manipulation of thread in the formation of a great variety of goods; for example in the wick of every paraffin lamp, in the thousands of miles of water hose of fire-fighting apparatus, in hundreds of thousands of miles of electric cable and in other instances too numerous to mention.

Nothing has been found to equal the unique properties of braiding. Knitting, though a sister process is not an adequate substitute; the latter as every house wife knows, can "unravel"; braiding never.

All this is well known where braiders are designed or made or used; but the designer, the maintenance engineer, and the works manager are at a loss to find a comprehensive work to assist them in improving or maintaining their machines.

There is a paucity of information extant on the subject. It is this need that has largely prompted the present treatise.

I know Mr. Douglass to be thoroughly competent to deal with the matter. He has spent many years in the shops and drawing office making a close study of braiders and their special problems.

The necessity for advance in design is emphasised by the fact that rates of output from a braiding machine are slow by any standard and very slow compared with rates of output from all other machines handling thread. This serious limitation is imposed by several factors, the principal one being the effects of centrifugal force on the parts travelling around the periphery of the machine. (To "rev the machine up" only aggravates the trouble). The bane of these centrifugal forces has yet to be circumvented if rates of output are ever to reach those of associated processes. In this connection, the present work offers a basis of proved factors with information on every aspect of the subject. It will make a valuable reference book add to every collection of industrial volumes.

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PREFACE

A shortage of up-to-date information regarding braiding machinery and braids induced the effort to prepare this book in an attempt to be of assistance to the many users of braiding machines.

Useful knowledge has been circulated by reputable manufacturers of braiding plant, but information from this source is of necessity somewhat limited, being mainly confined to catalogues or leaflets supplied with machines.

With this in mind, it was decided to describe some of the machines and put on record suggestions for overcoming a few of the problems all too frequently encountered when braid is being produced.

An elementary knowledge of machines by the reader is assumed, and as far as is possible, highly technical language has been avoided.

Acknowledgements are made to all manufacturers of machines mentioned or described in this work for their valuable assistance.

Many thanks are due to Mr. O. S. Johnson, Mrs. O. Phillips and Mrs. J. Simmons who volunteered aid with the preparation and correction of manuscript.

W. A. DOUGLASS

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INTRODUCTION

Braid is the formation of comparatively narrow fabrics or rope-like structures by interlacing diagonally three or more strands of material. A woman plaiting her hair, or English villagers dancing round the may-pole, and forming a braid of coloured streamers hang from the top of the pole, these were early historical examples of braid forming.

Braid is formed by crossing strands of material diagonally in such a way that one or more strands pass alternately over and under one or more strands being laid in the opposite direction. The earliest known braiding machines were made almost entirely of wood, but were soon abandoned in favour of the more robust machines of iron and steel built by the engineer. Most early braiders, crudely made compared with present day standards, were very effective and turned out some excellent work. In the lace industry where speed is relatively un-important, many of these old machines are still in regular service.

Many ingenious attempts have been, and are still being made to increase the speed and efficiency of braiding machines and in recent years braiders have been produced that, although limited as to versatility, are very much faster than the normal machine.

Functioning somewhat differently from the ordinary braider, these high speed machines will be described in later chapters.

In spite of these developments however, the original design of braider is still used extensively for certain classes of work, and for lace, fancy embroidery and elastic, remains as yet unchallenged.

Modern braiding machines are many and varied and although present day techniques and improved materials have advanced the performance, the basic design of slide plate machine has remained unaltered for the past two hundred years. Generally it is observed that there are four principal types of maypole braiding machines:

1. Soutache,
2. Tubular,
3. Flat,
4. Special.

BRAIDING MATERIALS

1.1. Some Common Natural Braiding Materials

Most of the materials used for braiding or weaving are of fibrous nature and can be classified into three groups: – Plant, Animal and Synthetic. A very short survey of the origin and processing of a few of the best known natural fibres follows.

Plant Fibres

The oldest and best known of all the plant fibres is Flax. The upper Nile valley in Egypt is generally regarded as the home of flax, but even so it is to-day grown and processed in many areas all over the world, and the methods used in some cases have remained unchanged all through history.

The bulk of flaxen yarns in use to-day are usually machine spun, thus ensuring an adequate supply in quantity.

Cotton

This is grown extensively in various parts of the world, America, Egypt and India being the main sources of supply.

Early in history the fibres were spun on distaffs and spindles with a deft twist of skilful fingers. Then came the familiar spinning wheel at one time a part of almost every household, mechanisation finally ousted the spinning wheel which is rarely seen to-day except in museums.

In its natural state, cotton varies from white to cream in colour and is almost invariably lacking in lustre.

Silk

According to Chinese records, silk worm raising was first undertaken about 4700 years ago in the province of Shantung. The silkworm is the larvae of a moth and its span of life is approximately fifty five days. During the first month of existence this creature consumes prodigious quantities of mulberry leaves and at the end of this period it stops feeding and finds a suitable nesting place.

Once settled it spins a cocoon around itself in preparation for transition into a moth. The average normal cocoon consists of roughly 4000 yards of delicate filament and takes about three days to produce.

If left alone the enclosed chrysalis would pierce a hole in one end of the cocoon and emerge as a moth within two weeks. This would render the filament useless for silk making and to avoid this the cocoons to be used for reeling are sorted for size and colour and then subjected to heat treatment in order to destroy the chrysalis before the transition period is complete.

After the heat treatment the cocoons are immersed in hot water to loosen the gummy substance that keeps the filament intact. A skilful reeler then takes hold of the filament ends of the number of cocoons needed to make a thread. These are then twisted together and reeled on a frame. Great skill and care is needed when joining filaments if the twisted thread is to be of uniform size.

Animal Fibres

Wool is perhaps the most common of animal fibres and comes from a few types of the many varieties of sheep all over the world. Wool is usually carded and formed into rolls in a similar fashion to cotton, and the carded rolls are suitably drawn and twisted into a continuous thread by spinning. Although not classified in quite the same way as wool, certain types of hair fibre are obtained from various animal groups thus adding to the variety of fibres in general use.

Synthetic Fibres

For many years chemists and research workers have struggled to produce artificial threads, and it is only within the last century that success has crowned their efforts. The first of these man made fibres to become a practical proposition was Rayon. Since then, progress has been extremely rapid and to-day there are many artificial filaments to choose from.

A cellulose solution is used for manufacturing Rayon, and the process which is complicated, varies considerably according to the type.

The solution is forced through a metal spinnaret with a series of holes in it, the number of holes varying from a dozen to several hundred according to requirements. These holes are accurately drilled to suit the type of yarn required and the long filaments formed on emerging from the spinnaret are twisted together for yarn manufacture.

Nylon, Terylene, Spun Glass are a few of the modern filaments being used extensively for both braiding and weaving.

Outside of the textile industry there is a certain amount of confusion regarding the sizing and yardage of various materials.

1.2. Yarn Count

The size of yarn or thread, determined by a length to weight ratio is called the count. When the letter S appears after a yarn size it represents a single thread.

Two systems are in general use based on the quantity of yarn spun from a certain amount of raw fibre.

The main difference is that with the cut system used for linen, wool, etc. and the hank system used for cotton, spun silk, etc. a low number means a coarse or heavy yarn.

The reverse is the case with the denier system, used extensively for artificial filaments, such as rayon, nylon etc. and a low number here means a very fine yarn.

The basis of the denier is the weight in grammes of 9000 metres of yarn.

A single denier would represent a single strand about 465 yds long and 5 centigrammes or $1/600$ of an oz in weight.

A filament of this size would be almost invisible and only used for experimental purposes.

Commercial sizes in general use vary from 15 to 1200 denier.

SYNTHETIC FIBRES (DENIER SYSTEM)

DENIER SIZE	APPROXIMATE LENGTH		WEIGHT	
	YARDS	METRES	OUNCES	GRAMS
1	465	425.5	$1/600$	.0472
10	465	425.5	$1/60$	.472
100	465	425.5	$1/6$	4.72

$80/2 = 2$ plies of 80/1 twisted together and an 80/1 would have $\frac{1}{2}$ of the yardage of an 80/2.

Linen

The unit for linen thread is the Lea. The length of a lea is 300 yards and the number of leas of a given size to one pound of material gives the linen thread size. The lower the number the coarser the thread.

LINEN THREAD

SIZE/PLY	APPROXIMATE LENGTH PER POUND		APPROXIMATE LENGTH PER KILOGRAM	
	YARDS	METRES	YARDS	METRES
10/5	600	549	1320	1207.8
30/1	9000	8235	19800	18123.6
40/2	6000	5490	13200	12078

Cotton

The hank forms the basis of cotton thread size. A hank is 840 yards long and the number of hanks to the pound will give the thread size: – 50 hanks each 840 yards long weigh 1 lb. and the cotton size will be No. 50.

COTTON

SIZE/PLY	APPROXIMATE LENGTH PER POUND		APPROXIMATE LENGTH PER KILOGRAM	
	YARDS	METRES	YARDS	METRES
8/4	1680	1537.2	3696	3381.8
20/4	4200	3843	9240	8454.6
30/3	8400	7686	18480	16799.2

1.3. Yarn Supply Spools

Innumerable types and sizes of supply spools and bobbins are in use for braiding machines but the present day trends are to dispense with the use of these varieties.

With the exception of wire spools which in almost every case have to be specially wound it is common to find that cop holders are in use on braiding machines.

The use of the cop-holder means that yarns can be obtained wound on to a plain cardboard tube of suitable dimensions ready to slip on to the cop-holder which in turn is dropped into place on the carrier supply pillar.

Unless the braiders in use are all of the same type some difficulties are usually encountered with spool sizes inasmuch as most of the braiding machine makers seem to have their own ideas about spool proportions and unless specific sizes are asked for there is a danger that when the

machine is put into commission special spools will be needed. Certain types of carriers, mainly those used in the heavier braiders are supplied with cop-holders as a permanent feature of the carrier but generally speaking the loose or separate unit is preferred. The majority of present day cop-holders or adaptors are simple ribbed steel tubes with some form of ratchet at one end made to fit whatever carrier is in use.

Almost any type of spool of suitable dimensions can be used, steel, aluminium, plastic, wood, or just a simple cardboard tube. Sometimes, however, circumstances prohibit the use of the cop-holder, more especially when delicate gossamer like filaments are being used for fancy braids. In cases like these a light plastic spool with ratchet teeth moulded in the base is to be preferred even though this means that the spools have to be specially wound.

For general braiding work yarn is wave wound on to a suitable cardboard tube, a feature of wave winding is that a neat firmly wound pack is formed during the winding process. Pay-out with this type of wind is reasonably smooth and the tendency for the formation of loose turns which could fall to the bottom of the cop and foul during braiding is considerably reduced.

For winding this type of pack, a fast cam operated traverse is used on the winding machine and the yarn or yarns are wound in the form of a long spiral.

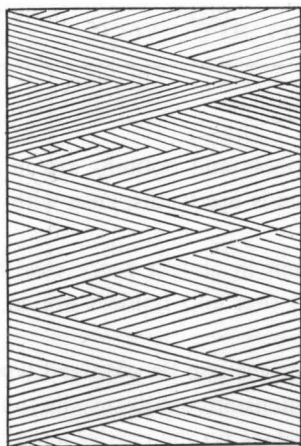


Fig. 1. Wave wound yarn pack

This results in a criss-cross pattern and it is common practice to describe a pack wound in this way by giving the tube bore, the diameter, length of traverse and the number of points or intersections that are visible in the wound pack. A typical 3 point wind is shown in Fig. 1.

Carriers on high speed rotary braiders are usually designed with spool accomodation as an integral part of the carrier thus rendering the use of cop-holders unnecessary. Spools for these machines should be wound as specified by the makers of the machine because failure to observe this simple ruling is often the cause of trouble during the braiding process.

Many of the modern synthetic yarns have certain peculiar characteristics, and these should be taken into account when considering spool winding or braiding operations.

Glass for example, is being used in ever increasing quantities for electric cable insulation. This fibre will stand up to fairly heavy tensioning but disintegrates when pulled over a rough surface. When using this material on high speed braiders it is advisable to keep contact surfaces to an absolute minimum and use wire guides in place of the standard yarn tension levers.

As with maypole braiders, running speeds of high speed machines are a constant source of controversy. At one time there was a tendency among the manufacturers of rapid braiders to recommend maximum speed regardless of the material used for processing. With the introduction of many new materials for braiding purposes it was found that it was impossible to apply the maximum speed rule to certain types of yarn and maintain an efficient output of quality braid. Variable speed drives are in use on many modern braiders and provide a very effective method by which operators can adjust the running speed of the braider to suit almost any circumstances.

1.4. Some Common Terms used in connection with Braid

Thread, Yarn or Fibre

Basic material used for the formation of braid. Principal materials are Cotton, Jute, Silk, Rayon, Nylon, Linen, Spun Glass etc.

Picks

Refers to stitches which form the braid. Flat braid is usually described by number of picks per inch.

Lines

These are formed where the stitches intersect and the number of lines is related to the number of carriers in the machine.

Plain Flat Braid

Usually made with an uneven number of strands and the resulting product takes the form of a narrow ribbon or tape.

Tubular Braid

Made with an even number of strands to form a tube and is used for hoses, fishing lines, cords, shoe laces, and cable and wire covering. Normally produced with a 2 : 2 stitch.

Diamond Braid

Sometimes referred to as a basket weave – this braid is formed with a 1 : 1 stitch.

Hercules Braid

This style of braid is not often encountered and is 3 : 3 formation.

Warp Threads

Vertical threads passed through the horngear spindles and interwoven in the braid. Rubber threads are processed in this way for the manufacture of braided elastic.

Rick-Rack

The finished braid takes a zig-zag formation and is produced by graduating carrier tensions.

Rubber Beams

This refers to the total number of rubber threads passed through the horngears of a flat braider for elastic production. In this instance all the rubber threads are wound on to a single let-off spool.

Ball Warp

The term used to describe a quantity of yarn supplied in bulk prior to being prepared for braiding. A ball warp consists of 378 ends of yarn each end approximately 6000 yards in length.

Skein

Silk, Rayon and Rubber threads are usually supplied in skein form, each skein consisting of a loosely coiled length of filament similar in appearance to skeins of knitting wool to be found in almost any drapery store.

Cop

A quantity of yarn or filament uniformly wound on to a cardboard tube.

Ply

The number of threads or filaments twisted together to form an end of braiding material.

End

A single length of material ready for use. More often than not multiple ends are used for braiding.

Fly

This is the name given to small wisps of thread that are rubbed from the yarn during processing. Depending upon the nature of the material it is sometimes a nuisance and at other times a blessing. In the majority of cases it is a nuisance especially with materials like asbestos.

MAYPOLE BRAIDERS

This type of machine is referred to as a maypole braider because of the similarity between the paths traced by the carriers and that of dancers round the maypole.

Simple slide plate machines consist of a deck, driving mechanism and a super structure on which is mounted the take-up sheave or rolls and the braiding die or guide. The deck is simply two flat plates of cast iron or steel bolted together by means of a series of spacer studs. In the upper or top plate serpent-like tracks are cut in such a way that they form a series or chain of inter-connected figure eights. Extreme care has to be exercised in cutting and setting these tracks as they form guides for the spool carriers and any irregularity will cause excessive noise and wear.

Between the two plates, arranged in formation to suit the tracking, is a train of gears. Attached to or forming part of each gear is a circular flanged top which is slotted or shaped to engage the bottom driving pins or lugs of the spool carriers. These horngears as they are termed are

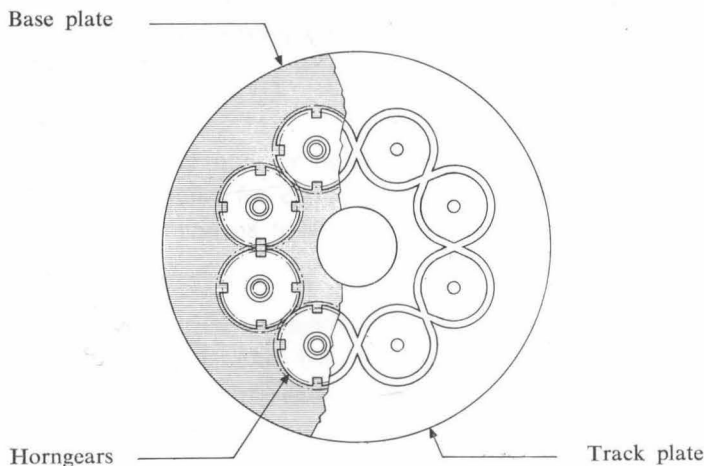


Fig. 2. Horngears and tracking (tubular braider)

assembled so that the slots in the top flange co-incide at intersections in the tracking (see Fig. 2). Thus a bottom carrier lug in one of the horngear slots will propel the carrier round the track until it reaches an intersection. The contour of the track then causes the carrier lug to be transferred from

one horngear to the next and this process is repeated throughout the entire length of the tracking.

On a frame, usually mounted centrally over the tracking, is the braiding die and directly above this is the take-up sheave or flat rolls for disposing with the finished product. The disposal gear can be arranged in a variety of ways, a take-up sheave being used for circular work and a roll system for flat work.

Whatever the set-up, the feed gear is driven by change gears that can be readily varied to suite the style of braid required. The change gears are driven via a worm reduction gear, the input shaft of which is attached to an idler gear in mesh between the horngears and the driving mechanism.

The same input shaft in the majority for small braiders provides the means of turning the braider by hand for setting up, etc., and is usually fitted at the upper extremity with a handwheel.

The driving mechanism of conventional braiders is attached to the bottom plate of the deck and consists of one of the following assemblies:

– A driving pulley incorporating a dog clutch, a fast and loose pulley, or a geared or V-belt motor drive.

Knock-out levers, or in modern machines electrical cut-outs are fitted to the tracking so that in the event of yarns or wires from the carriers becoming foul or broken the driving mechanism is disengaged or the driving motor is stopped. Feeds are arranged over the centre or to one side of the machine, the finished product being drawn from the braider in various ways. Flat or fancy braid is drawn from the machine via a system of feed rolls and discharged over the side or back of the machine into a suitable container.

For cable and wire covering, tubular braid or solid cords, a take-up sheave is used and provision has to be made for let-off and reception reels.

Braiding machines for elastic are conventional except that the horngears rotate on hollow bearings. Strands of rubber under tension are pulled through each hollow bearing to be woven into the braid. Provision has to be made for maintaining these rubber strands in a uniformly stretched condition as they are passed through the machine.

2.1. Some Common Types Maypole Braiders

1. The “Soutache” Braider

“Soutache” braid is a narrow trimming that is easily laid into curves or shapes. It can be formed into ornaments and loops and is used for embroidery and dress trimmings. The machine used for this work is the

simplest of all braiders. The carrier tracking is in the form of a figure eight and there are two horn gears with an uneven number of slots. The two horn gears are slotted to take 3, 5, 7, 9, 11, 13 or 17 carriers. The three carrier machine is used for the manufacture of candlewick, sweater girdles, hat felts, shawls, etc. (See Fig. 3).

2. *Tubular or Solid Cord Braiders*

These braiders are used for a wide variety of goods such as fishing lines, shoe laces, sash cords, rubber tube reinforcements, high pressure hoses,

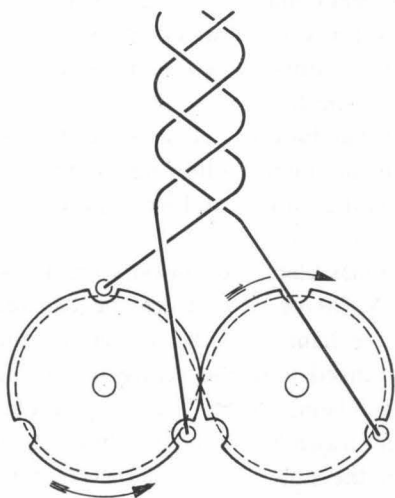


Fig. 3. Diagram of 3 carrier "Soutache" set-up

packing, cable and wire covering and more recently for the manufacture of synthetic arteries.

These machines always have an even number of carriers starting with eight and increasing by steps of four to forty-eight in the standard ranges.

3. *Flat Braiders*

Similar in appearance to tubular braiders, the machines used for flat work differ in respect to the take-up or feed gear and the carrier tracking. The carrier tracking does not completely encircle the braiding centre as in the tubular braider (Fig. 4). Two horn gears, normally in front of the machine, have an uneven number of horn slots.

To keep the timing correctly related these two gears have usually a larger number of teeth and correspondingly the contour of the tracking

above these two gears describes a larger arc. Thus, instead of two complete tracks intersecting at regular intervals as in the tubular machine there are

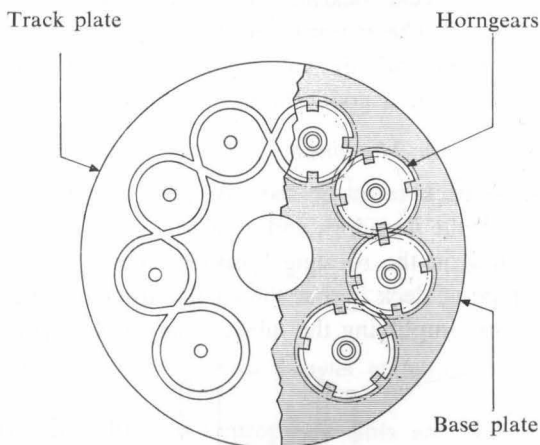


Fig. 4. Horn gears and tracking (flat braider)

two shorter, incomplete tracks which reverse at each terminal gear. If so desired braiders can be made in such a way that by substituting special parts the same machine can be used for either flat or tubular work. Flat braid is commonly used for shoe laces, tapes, embroidery, elastic and ornamentation for uniforms.

2.2. Special Braiders

These are non-standard machines and include those used for Square, President, Vienna and Solid Cord Braids. For certain types of lace some very elaborate machines were built in the days when lace was fashionable. Occasionally, a tubular braid specification will call for two or even three sheaths and should sufficient quantity be needed to justify the expense of a special machine a two or three decker braider can be obtained which will obviate the necessity of passing the work through a single deck machine two or three times. Some of these unusual machines, which nowadays are rare will be described in later sections.

2.3. Maypole Braider Decks

When applied to braiding machines the term "deck" refers to the track and bottom plate assembly complete with horn gears. Two types of deck assembly are in general use:

1. Slide Plate with Fixed Quoits

"Quoit" is the name given to the small plate that is fastened to the top of the horngear bearing post and which forms part of the tracking system. The majority of these machines are of English or American origin and are called slide plate braiders because the carriers have to be a good sliding fit in the track plate.

2. Carried Carrier Machines

This type of deck seems to have originated in Germany. Tracking is underneath the horndogs and as the name implies the carriers are carried round on the rotating horndogs. One advantage associated with this type of deck is that the carrier tracking can be used as an oil bath, thus simplifying the lubrication problem (Fig. 5).

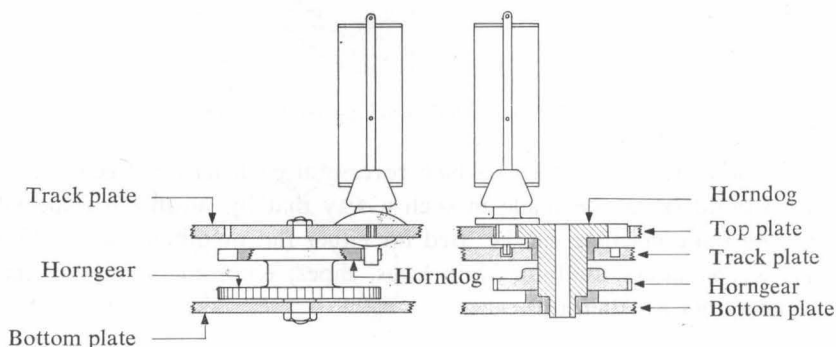


Fig. 5. Sectional view of slide plate and carried carrier decks

Horn gears are an essential feature of all maypole braider decks and it is customary to define the size of the machine by quoting the pitch circle diameter of the horn gears and the number of carriers. Accurate timing is necessary both with the horndog slots and the gearing if smooth running is to be achieved.

Three styles of horngear assembly are shown in Fig. 6. A typical horngear consists of a machine cut spur gear on one side of which is an extended boss. Forming part of or fastened to this extended boss is a disc, the thickness and diameter of which depends upon the size and nature of the braider.

With the normal tubular machine a set of these gears are arranged in circular formation, eight for a sixteen carrier machine, twelve for a twenty-four carrier machine and so on. Four slots are cut in each horngear disc at 90° and the gears must be positioned so that when rotating the slots must coincide with extreme accuracy at each intersection of the

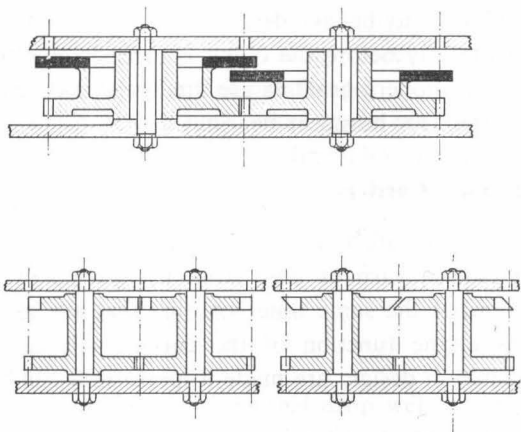


Fig. 6. Sectional view showing 3 styles of horngear assembly

tracking. Carrier lugs fit into appropriate slots and the rotation of the horngears propel the carriers round the track. When a carrier reaches a track intersection it is compelled by the contour of the track to transfer via the slots, from one horngear to the next and this transfer process is repeated throughout the entire length of the track until a convolution is completed, when the cycle starts all over again.

The lubrication of horngears and tracking is forever a problem and when the braided product is of such materials as asbestos, cotton or yarns of fluffy nature the braider becomes smothered with fly after a few hours of running time. Materials of this nature rapidly choke oil holes and absorb any surplus oil on the track plate.

Oiling of horngear bearings and tracks must be undertaken as a routine

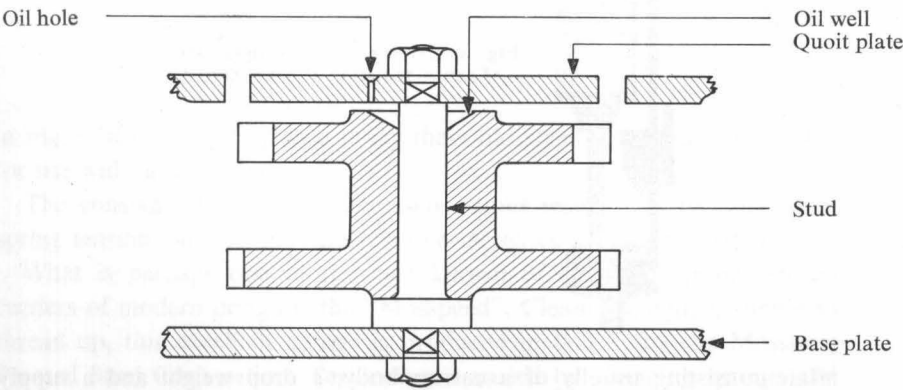


Fig. 7. Horngear lubrication (slide plate machine)

operation if trouble is to be avoided, care being exercised to clear oil holes of accumulated fly before the oiling is carried out (Fig. 7). A good many of the heavier, modern braiders are fitted with a centralized pressure fed lubrication system for horn gear bearings.

2.4. Maypole Braider Carriers

An important feature of all braiding machines is the method adopted for paying out the cotton, yarn or wire from the source of supply to the braiding centre and at the same time ensuring that the braid is correctly formed and this is the function of the carrier. All carriers, although varying considerably in design, are made to perform a combined sequence of operations: —

1. Carry a bobbin of material.
2. Maintain tension on the material.
3. Pay out the correct quantity of material as required.
4. In the event of the material running out or becoming foul or broken the carrier should automatically stop the machine.

A well-designed carrier should combine simplicity, rigidity lightness and a minimum of working parts.

The older type of carrier, many of which are still in use, was a simple

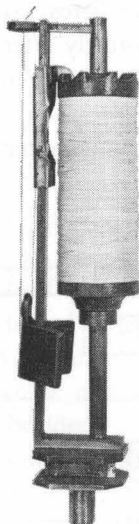


Fig. 8. External drop weight carrier
(*Textile Machine Works, U.S.A.*)

affair consisting usually of a carrier body, a drop weight and a supply release pawl. Drop weights were made in various sizes and to increase

or decrease tensioning simply means changing the weight. The supply spool is normally a wooden or metal flanged reel with a series of ratchet teeth arranged in the outer face of one flange.

Simply constructed and in most cases made entirely of cast iron these carriers could be used to produce a first class braid although running speeds were low.

Until the introduction of the spring tension carrier two styles of weighted carrier were in general use:

1. External Drop Weight Carrier.
2. Tube or Pipe Carrier.

A good example of the plain external drop weight carrier is shown in Fig. 8, a fabricated steel construction by Textile Machine Works, U.S.A.

The tube or pipe carrier, although not as easy to thread up as the plain drop weight carrier, has the advantage that working parts that need lubricating are enclosed, this minimising the danger of soiling the braided product. Neatly designed pipe carrier by Textile Machine Works is shown

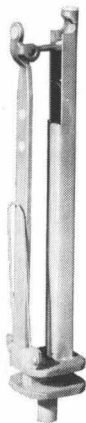


Fig. 9. Tube or pipe carrier
(Textile Machine Works, U.S.A.)

in Fig. 9. Rarely seen or used today these old style carriers are unrivalled for use with delicate materials.

The constant clamour for increased output resulted in the advent of spring tension carriers and considerable increases in running speeds.

What is perhaps one of the best known of standard spring tension carriers of modern design is the "Mosspeed". Cleanly designed, simple to thread up, this excellent carrier is produced in U.S.A. by the Mossberg Pressed Steel Corporation. Tensioning is varied by changing springs and this operation can be accomplished without the necessity to use tools. It

can be readily obtained in various sizes to fit almost any standard braider and high running speeds are possible.

Present day trends in design favour built-up steel carriers with a maximum spool capacity but if a long working life is desired there are certain advantages in the use of carriers with a high quality cast iron base and normal spool capacity. Modern tendencies are evident in the latest Carter "Ace" carrier (Fig. 10). This is a built-up steel carrier with

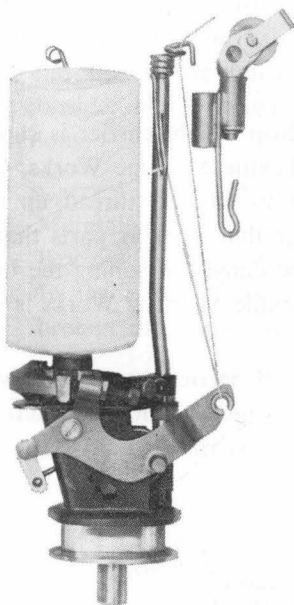


Fig. 10. A modern yarn carrier
(B. & F. Carter, Bolton, England)

oversize spool accommodation and the supply release can either be the conventional ratchet and pawl system or a tension controlled expanding brake. An unusual feature of these carriers is the method adopted to ensure a firmly fitted yarn spool.

The copholder is a permanent attachment and a circular section rubber ring is fitted over the copholder tube. When the cardboard cop tube is pushed on to the copholder it rolls the rubber ring down the centre tube of the copholder whereby the cop tube is gripped firmly in position.

Another feature exclusive to the heavier types of Carter yarn carriers is the bracing link. This consists of a detachable link which, when in position, firmly couples the tension post and the copholder pillar together. This minimises the tendency of the tension post to whip, an undesirable feature that is all too prevalent with the long and sometimes slender tension posts.

Carriers for slide plate braiders have the track follower in between the base flanges with the horndog pin or lug protruding from underneath the bottom flange.

Carried carriers, however, are arranged with the horndog pin in between the base flanges, and the track follower which in some modern carriers is articulated and detachable is underneath the base flanges. A typical German carrier of this type is shown in Fig. 11, this being one of the

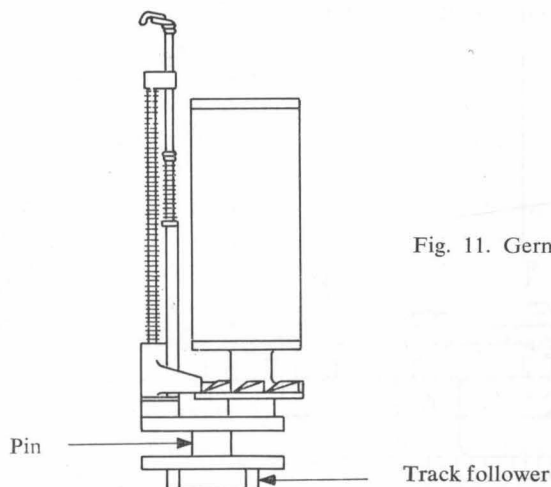


Fig. 11. German carried carrier

earlier types with a fixed track follower forming part of the base casting.

Two advantages with the carried carrier are:

1. Articulated track followers make for smoother running.
2. Worn followers are easily replaced, saving the expense of a carrier base or as is sometimes the case with smaller machines a complete new carrier.

It is customary to specify the size of a maypole machine by stating the number of carriers and the pitch circle diameter of the horngears: — A 4" horngear machine is usually classed as a table or bench braider, whereas a $7\frac{1}{4}$ " horngear machine is a heavy duty braider for yarns or wire.

As seen from Fig. 12 the horngear diameter imposes definite limits on the size of the carrier spool or bobbin and any attempts to use oversize spools will be frustrated because of spools fouling. The height of a carrier must also be given a careful consideration because a very tall carrier will have a marked tendency to whip and vibrate when the machine is working and this in turn will increase the carrier loading pressure on the tracking

and followers and also tend to produce erratic effects on the tensioning. Three styles of carrier spool supply release are seen in Fig. 13.

1. *The Bobbin*, which can be either of the top or bottom latch type.

The disadvantage of this type of supply is that the yarns will

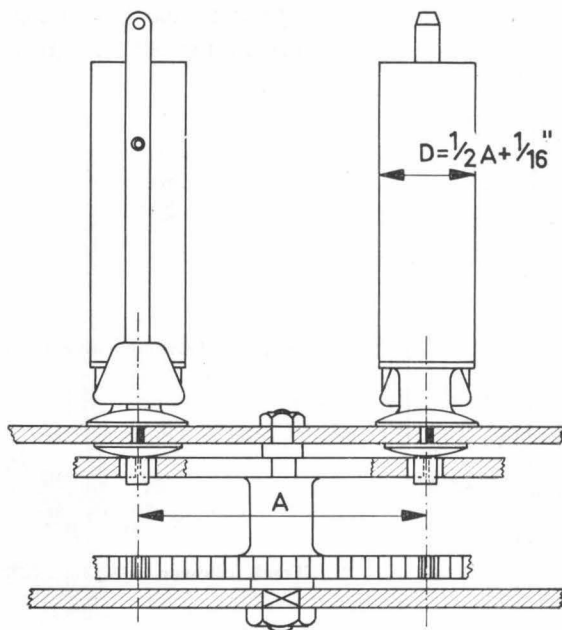


Fig. 12. Maximum diameters of spools

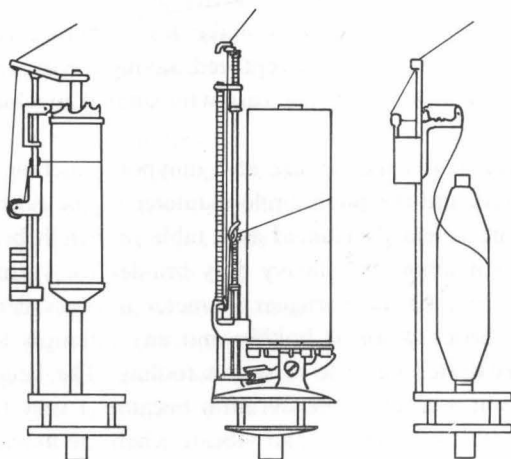


Fig. 13. Types of carrier yarn supply

have to be wound on to these bobbins as an extra operation.

2. *The Copholder*. This is the most generally used form of yarn supply because the material can be supplied ready wound on to a cardboard tube that can be slipped on to any standard copholder. Yarn capacity is usually increased with this form of winding.
3. *The Fixed Cop*. Rarely encountered, it can be seen from the diagram that with form of supply the yarn is drawn over the top end of the taper ended spool and tension is maintained by pulling the end through a pressure labyrinth.

Regarding tubular maypole braiders it is not generally realised that unless carrier supply ratchets are handed there is a tendency for irregular track wear.

When the machine is working the carrier supply release pawls receive continuously a succession of heavy slaps or knocks from the copholder ratchets as the yarn is being paid out.

In one direction this slapping is additional to the centrifugal pressure and results in extra loading on the tracking by the carrier track follower. Carriers running in the opposite direction also set up this chatter but in this case the slapping is in opposition to the centrifugal pressure and to some extent tends to reduce the pressure and wear on this section of tracking.

This unequal wear effect is most pronounced with yarn braiders and can be nullified to some extent by inverting the corps on carriers where the slapping is in an outward direction. Nevertheless, this practice is not recommended because of the tendency to confuse operators. Handed carriers on the other hand mean extra expense and it is debatable whether or not this extra trouble is really worth while.

2.5. Maypole Carriers for Wire

Flexible metallic screening used on cables for aircraft or television and also high pressure hose reinforcement or protection are mainly responsible for ever increasing demands for high quality braiding. It is possible to manufacture a limited range of fine wire braids simply by slowing down a standard yarn machine and adjusting carrier tensions to suit but the resulting product is rarely satisfactory. Wire carriers are of necessity specially designed and with very few exceptions the spool or reel of wire is mounted horizontally in the carrier.

With vertically mounted spools there is always a tendency for a few turns of wire on the outer layer to spring open slightly, fall to the bottom of the spool and foul the winding, thus causing broken wires. Also with vertical spools there is always the temptation to use a reel with a long traverse. This is undesirable because of erratic tensioning effects that produce irregular braid with an occasional riding wire.

A typical modern heavy duty wire carrier by W. & M. Ostermann (Germany) is illustrated in Fig. 14. This is a carried carrier with twin

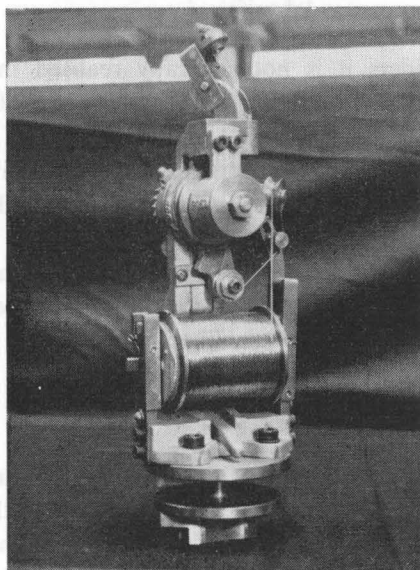


Fig. 14. Modern German wire carrier
(W. & M. Ostermann, Germany)

track followers, detachable base, and a swivelling top outlet for the wire. Swivelling tops or outlets are essential when coated wires are being braided in order to minimise the risk of damage to the coated surface.

A built-up steel slide plate carrier is shown in Fig. 15, made by B. & F. Carter (Bolton), the illustration clearly shows the rigid construction so very essential where wire carriers are concerned.

Generally, present day trends are for the use of spring tensioning in order to increase running speed but, nevertheless, it is possible to produce first-class wire braid by reverting to the use of weighted carriers (Fig. 16 B. & F. Carter).

A reduction in running speed will be necessary but if quality braiding is desired the use of this type of carrier is well worth consideration.

Carrier speeds for all types of maypole braider fall within well defined

limits and although constant attempts are made to improve on these speeds the unusual nature of the maypole braider has so far prevented any spectacular increases in running speed.

Where wire braiders are concerned, the nature of the materials used,

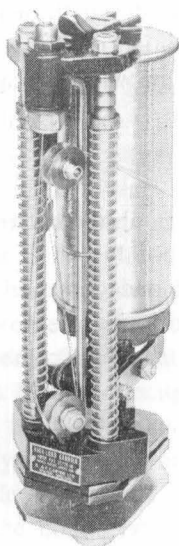


Fig. 15. A wire carrier of English design
(B. & F. Carter, Bolton, England)



Fig. 16. A wire carrier with weighted tension
(B. & F. Carter, Bolton, England)

together with the combined weight of carrier and wire inevitably cause an essential reduction in running speed. Normally, this reduction amounts to some 30 % to 40 % of an equivalent yarn braider speed. Thus a 24 carrier, 4" horngear yarn braider will run well at approximately 42 convolutions per minute whereas the same type of machine braiding wire would

have to convolute at approximately 30 per minute for satisfactory running.

Casual observers often ask – “Why does a sixteen carrier machine apparently run much faster than a similar machine with 24 carriers?” Actually the tracking speed is approximately the same in both machines but in the case of the 24 carrier machine the overall length of tracking is some 50 % longer. Therefore, should the convolution rate of a 16 carrier braider be in the region of 60, a similar machine with 24 carriers will operate at 40.

2.6. Feed Gears and Take-Ups

In order to produce a good quality braid it is absolutely essential to draw the finished product from the machine smoothly and at a perfectly uniform rate. A slight jerk will open the braid and conversely a pause will cause crowding. The important function of drawing the product from the machine is taken care of by the feed gear, usually a combination of

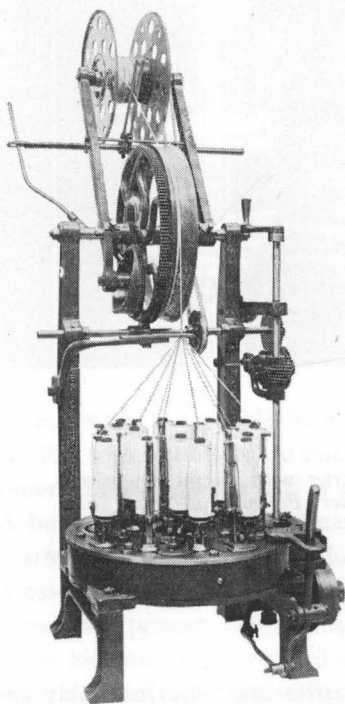


Fig. 17. A 16 carrier tubular braider
(B. & F. Carter, Bolton, England)

worm gearing, change gears (for various braid requirements) and some form of take-up sheave or rolls.

With the normal tubular braider, the feed gears drive a capstan or take-up sheave. An exception to this is the modern horizontal braider

which uses some form of caterpillar to draw the product from the machine. Certain types of hose braider which are horizontal are equipped with a chain conveyor system to support the mandrel during braiding operations.

Flat braiders, however, are normally equipped with a system of rolls, performing the double function of keeping the product flat and discharging it via a suitable chute into a container.

A wide range of feed gear assemblies are obtainable for New England Butt Braiders (U.S.A.) and these are standardised in such a way that it becomes a simple matter to change any of them without having to recourse to machining or fitting.

Feed and take-up gears are well illustrated in Fig. 17. This shows a 16 carrier tubular braider by B. & F. Carter (Bolton). The reception reel is at the rear and above the take-up sheave and a neat example of cam-operated auto-traverse is clearly shown.

With soft, flat braids reception arrangements are extremely simple – usually a bin or container suitably placed. For cable or wire covering, however, the finished product is normally wound onto a reel or drum and for this type of reception some form of slipping drive has to be installed.

Consider a reel with a 12" barrel and 24" flanges and assume that the reel at the commencement of operations is being driven at 10 r.p.m. Without going into detailed calculations it should be obvious that if the reel is driven at constant speed undesirable tension will be created in the cable or wire as the successive layers build up on the reel (Fig. 18). The

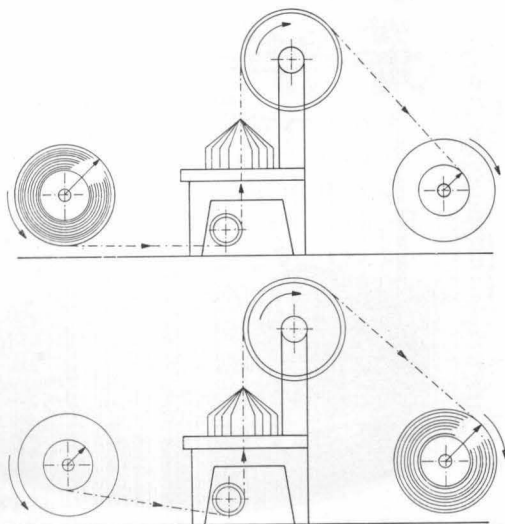


Fig. 18. Compensating drive for wire & cable covering

linear speed of the product when wrapped on a 12" barrel rotating at 10 r.p.m. will be approximately 31.4 ft. per minute. When full flange diameter is reached the lineal speed will be doubled or 62.8 ft. per minute, assuming that the drum is positively driven.

By arranging the reel driving mechanism so that the reel can slip, this variation factor is taken care of and the extra weight provided as the reel fills up helps considerably to produce this essential slipping effect. With some of the heavy braiding machines used for armouring or wire screening uniform slipping becomes a formidable problem.

Frequently the most effective method in use is probably the oldest i.e. a plain jockeyed rope drive.

Many modern braiding machines are equipped with a slipping clutch drive but even so it is not easy to provide a satisfactory slipping system for the wide range of reels in general use.

2.7. Some Unusual Braiding Machines

Standard braiding machines are readily available for general work but occasionally a special purpose product calls for an unorthodox machine. A typical example is shown in Fig. 19 – $12 \times 24 \times 12$ carrier 90 m/m stripe braider by Textile Machine Works, U.S.A.

Fig. 20 shows clearly the complex nature of the tracking in some of

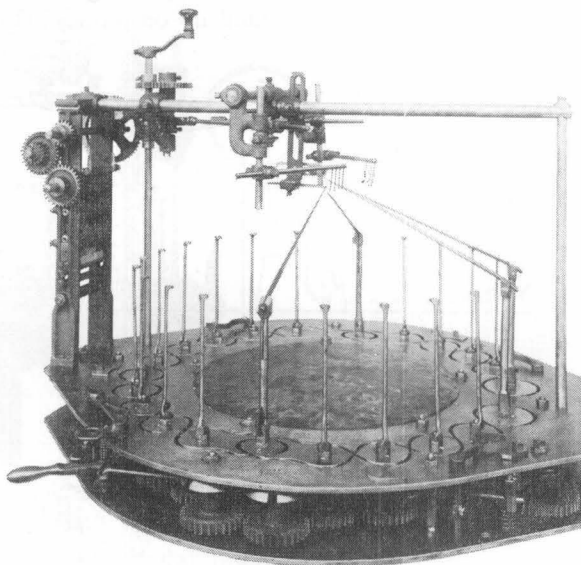


Fig. 19. $12 \times 24 \times 12$ simple stripe braider (*Textile Machine Works, U.S.A.*)

these special machines. This is a $12 \times 9 \times 24 \times 9 \times 12$ carrier braider deck, also by Textile Machine Works, U.S.A.

A wide variety of tracking lay-outs appeared when fashion decreed the use of fancy braid or lace but the present day trends are for the use

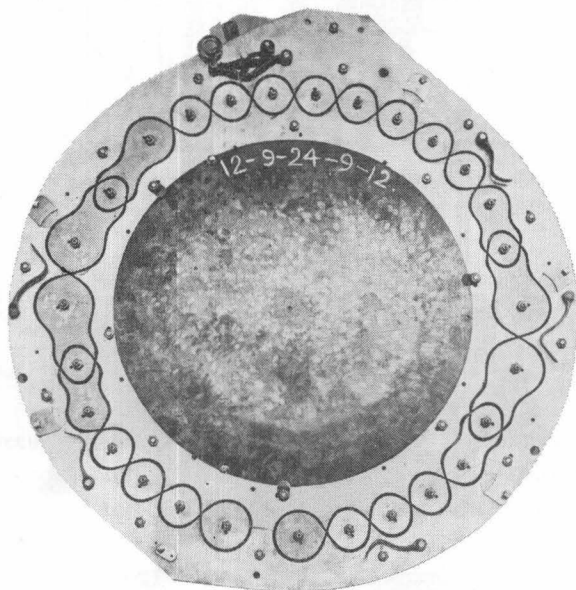


Fig. 20. $12 \times 9 \times 24 \times 9 \times 12$ stripe braider tracking
(Textile Machine Works U.S.A.)

of standard braids. Some of these unusual tracking circuits will be described later.

Fig. 21 shows an inverted braider by B. & F. Carter and this type of machine is designed for the manufacture of circular or square soft packing for pump glands, steam cylinder stuffing boxes, etc. The packing is made in dry condition or grease impregnated as circumstances demand. Yarns are fed from the top of the machine to form the core and four tubes are fitted so that yarns can be passed through the tubes for corner fillings.

The yarns forming the packing are passed through a conical grease container situated directly underneath the inverted carriers. This container is steam heated to ensure thorough impregnation. By arranging the process in this way the yarns are well saturated prior to and at the braiding centre and thus what would have been an extremely messy process on a normal vertical braider is avoided.

Some unusual mechanical features are to be found in the precision made

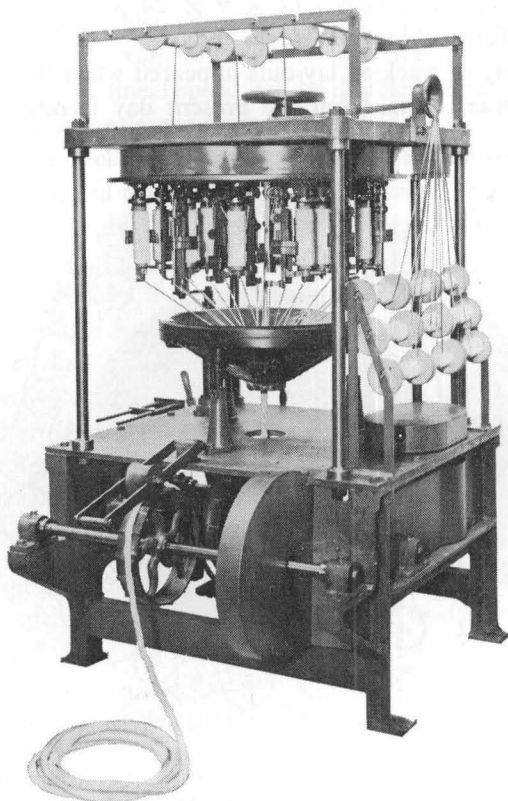


Fig. 21. Inverted packing braider (*B. & F. Carter, Bolton, England*)

maypole braider built by Hobourn Aero Components Limited of Rochester. Track plates are of flame hardened steel and carrier entry points on both inner and outer plates are fitted with renewable hardened inserts (Fig. 22). Horngear bearing bushes of hardened and ground steel are shrunk into the bottom plate by the liquid oxygen process.

This braider is a carried carrier machine and instead of the usual oil bath tracking there are small circular gunmetal transfer crossings situated underneath the top plate at all the carrier transfer points. Horngears are secured to the horndog shank by means of a tapered cotter pin which is firmly locked in position with an "Allen" grub screw once the horndogs are correctly timed. The remainder of the machine is conventional except for the carriers. These are fabricated entirely of steel, the carrier base and track follower being case hardened.

Some neat design work is evident in the compact braider produced by E. Brondel of Lyons (France).

Fig. 23 shows diagrammatically the unusual nature of the horndogs.

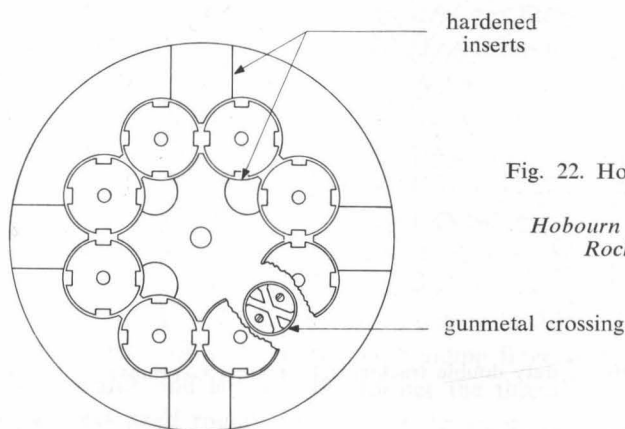


Fig. 22. Horngears and carrier transfer

*Hobourn Aero Components,
Rochester, England*

The centre recess or horndog slot accommodates the main carrier lug and the shallow recesses on either side of this slot are designed to distribute working pressure on the carrier and also take the shanks of the swivelling

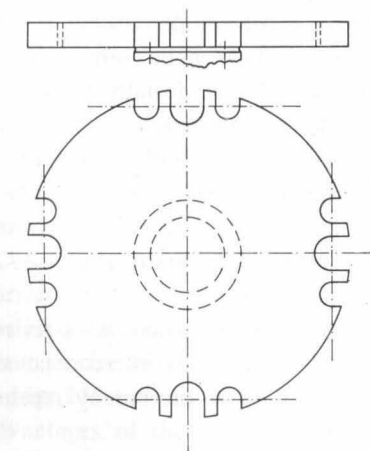


Fig. 23. Horndog of French design
(E. Brondel, Lyon, France)

carrier track followers. Articulated track followers tend to minimise track wear and permit increased running speeds.

A further development in this form of tracking is seen in Fig. 24. This shows a section of heavy duty double tracking associated with some of the large wire braiders produced by A. Herzog (Germany).

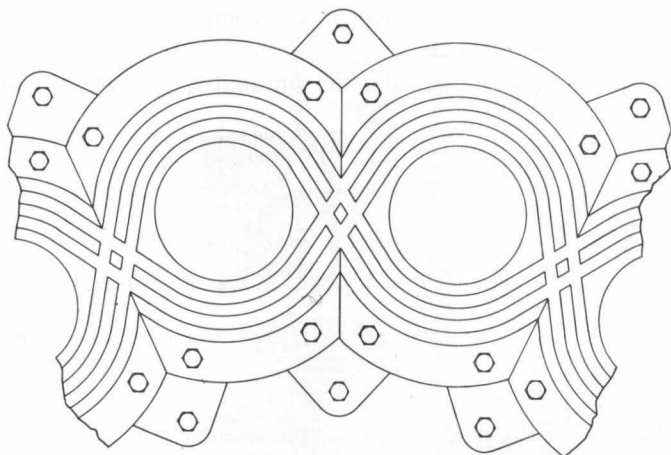


Fig. 24. Heavy duty double tracking (*A. Herzog, Germany*)

2.8. Maypole Braiders Used for Lace

Braiding machines for the manufacture of strip lace are slow running and in many instances extremely complicated. With the present day trends in fashion there has been a considerable decline in the use of lace and, in consequence, these interesting machines are seldom encountered.

The majority of these braiders seem to have been built in what is the home of the braided lace industry – Wuppertal Barmen in Germany.

Lace manufactured on these machines, which are usually jacquard controlled, consists normally of single bands, the threads of which are transferred from one band to the other. Binding of threads in jacquard and cross bound lace is two plait: one thread always crosses over and under two other threads. The exception is in places where threads cross from one band to the other and these are five plait in jacquard and 2–1–2 in crossbound laces.

The complicated tracking of these machines can be likened to a series of tracks cut in one large plate, each section of which is interconnected so that carriers can be switched from one section to another by means of switch over points or repeat mechanisms.

Carriers with drop weights or gravity tensioning are usually preferred for this type of work.

Machines with 9 carriers per band figure largely in lace work, usually 2×9 , 3×9 , 4×9 , etc., with stronger end bands such as $2 \times 9 \times 18$ or $3 \times 9 \times 27$. Occasionally, however, braiders with 7, 11 or 13 carriers per band are used.

An open-work fabric, a lace or an insertion is produced if some of the carriers cross over and some turn in their own band according to a pattern. Early machines used repeat wheels for actuating the points and turn plates but the majority of present day braiders are fitted with jacquards.

The jacquard can best be described as a mechanical forerunner of the modern punched card system. Briefly it consists of a caterpillar mechanism driven by the braiding machine. The caterpillar is formed of a series of rectangular cards, and holes are punched in these cards according to the nature of the pattern desired. A hole in the card will cause the turnplate to open or throws the points in the braider tracking and thus regulates the crossing of carriers from one band to another. An experienced operator can readily trace the course of carriers by studying the jacquard cards.

For making lace with open or closed eyelets on the edges outrunners are used and if on each outrunner braiding fingers are fitted with points bent upwards and led into the former the thread passing over the outrunner lays itself round the point of the finger and forms a loop in the fabric. With several outrunners and correct adjustment of the braiding fingers loops of various sizes can be formed at the edge of the pattern. Binding of various threads is accomplished by using beating combs or a crown beater over the formers.

Close above the former the fabric passes through two small fluted rollers and, if necessary, these rollers can be adjusted so that one edge of the lace becomes longer than the other. Between the ruché-box and the take-up rollers the lace is guided through a tongue which widens the lace and makes the pattern distinct.

Some idea of the production rate of lace braiding which varies widely according to the type of lace and is quite often ranged between four and ten yards per day.

Generally, lace braiders are slow cumbersome machines with many carriers. Sometimes it is necessary for some carriers to remain stationary for a period while the remaining carriers are in motion and this is usually arranged for by fitting a clutch mechanism to individual horn gears.

Fig. 25 shows a typical jacquard-operated 2-thread lace braider. The advantages of the 2-thread system are that alternately the twist of the thread opens to the left and closes again to the right. Based, therefore, on twist the strength of the thread remains constant even when, as is sometimes the case, the carrier remains running in the same tracking for some considerable time.

With three and four thread lace machines the same broad principles are followed with the exception that a slightly different horn gear and

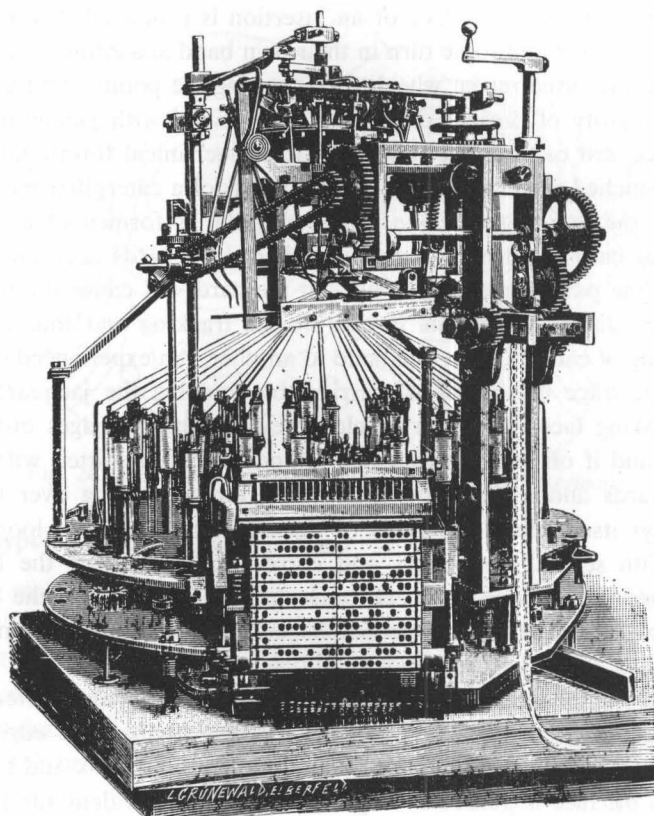


Fig. 25. Jacquard controlled lace braider (*Joh. Fries, Wuppertal-Barmen, Germany*)

tracking set-up is used for each band. Although at first sight a lace braider appears to be very elaborate, especially if fitted with some of the numerous attachments available for special pattern work, basically it consists of a series of simple braiding formations interconnected by means of switch or change points. Combs, crown beaters, knot catchers, loop attachments and a host of other special devices are available for producing ornamental plaiting.

From the very brief description of fancy braiding it is apparent that this is a specialized branch of braiding and considerable experience is a must for the successful production of pattern work.

With many materials work can be undertaken without having to consider conditions but there are times when even the temperature and humidity of the workroom become extremely important.

With lace the pattern is defined in many cases by the carrier tracking

and skill and experience are essential for pattern forming. Even so the majority of lace designers seem to have little difficulty in creating a pattern by direct reference to the carrier tracking. In this respect too, the jacquard, or tracking control, has simplified the job of forming patterns.

To sum up, the lace braiding machine is a useful aid for producing ordinary commercial laces and although the demand is small compared with the requirements in the days of the Victorian era there is, nevertheless, sufficient healthy activity to warrant continued progress in the design of machines for this purpose.

2.9. Braiders for Elastic

The lattice formation of braid is extremely useful when considering the manufacture of elastic. Elastic produced on braiders can be readily distinguished from woven elastic by shrinkage in width when stretched.

For example, a $\frac{3}{4}$ " woven suspender web loses 2 % in width when stretched to its limit. A $\frac{3}{4}$ " wide braid under the same conditions loses some 40 % in width.

The insertion of rubber threads into woven or braided fabrics creates many problems due mainly to the difference in the physical properties of rubber as compared with threads of silk, cotton or nylon. The majority of yarns, synthetic or natural, must be considered as rigid, whereas rubber thread is perfectly elastic. Only the purest of rubber is normally used for the manufacture of rubber threads and great care must be exercised both during processing and storing. Exposure of a freshly made rubber thread to strong sunlight will render it completely useless as an elastic thread in a very short time. Rubber threads should be stored in cool, dark rooms free from draughts and radiators and when used in a braiding machine it is important to avoid sunlight at all costs.

Two types of rubber thread are in general use for the manufacture of elastic: – Round, which is processed direct from latex, and Square, which is cut from rolled sheets. Under normal conditions lactron or round thread has approximately three times the working life of square cut. In practice a good quality rubber thread should have a maximum extension of about 800 % i.e. a thread 2" long should stretch to 18" before breaking. Extension is important because rubber webs are manufactured under tension and this stretch is usually in the region of 400 % thus allowing a factor of safety of 2.

For the manufacture of ribbon elastic flat braiders with hollow or tubular horngear bearings are used. The rubber threads are pulled through

the horngear studs under controlled tension by the action of the braiding machine. Uniform thread tensioning is quite a problem because the braid has to be formed while the rubber threads are in stretched condition. Sometimes the strands of rubber are tensioned individually by hanging a weight on the rotating flange of the supply spool (Fig. 26). With this

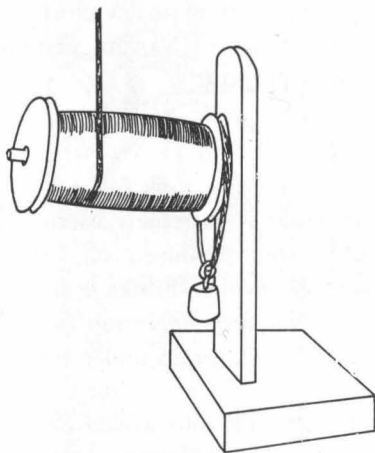


Fig. 26. Simple tensioning for rubber threads

method it is difficult to maintain a uniform tension on all the spools.

Spools are seldom identical and friction between the cord holding the weight and the spool flange will be subject to considerable variation and this usually results in bowed or cockled braiding.

Another method in common use is the rubber beam. The required number of rubber threads are carefully wound on to a single spool which is carefully positioned underneath the braider.

Fig. 27 shows a typical twin head braiding machine set up for the production of ribbon elastic. The simplicity of the method of tensioning the rubber beams is clearly visible underneath the deck. In certain circumstances the rubber threads are wound on to the feed spools under tension to increase thread capacity. When spools are wound in this way there is the hazard of trapped turns on the spool and this could cause erratic braiding. Another undesirable feature associated with tightly wound spools is fatigue. The extent of fatigue depends on the magnitude and duration of excessive tension and this can also cause irregular braiding.

So far only the production of plain flat braided elastic has been considered but, of course, it is possible to produce innumerable decorative

effects merely by using different coloured yarns, varying the number of inserted rubber threads or re-arranging carrier formations. To give an example, a 17-carrier braider is producing a four line flat braid and the number of rubber threads passed through the horngear studs will be eight. Leaving out two of the rubber threads, one through the five slot terminal horngear stud and one through the adjacent horngear, a crinkly decorative effect, will be produced on one side of the braid. This effect can be produced as desired by leaving out rubber threads in various positions. Many patterns can be produced by means of these simple alterations but it is necessary to have a thorough knowledge of the mechanics of the braider and also the nature of the materials used for the braid.

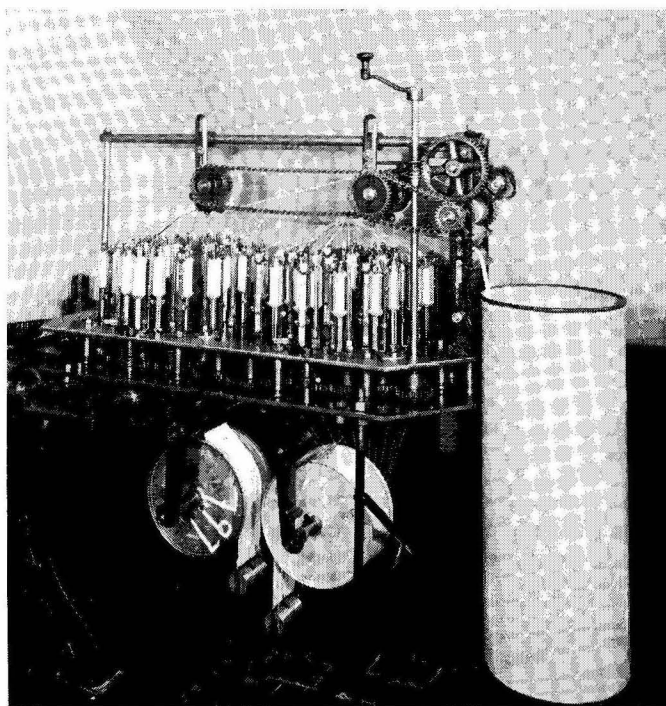


Fig. 27. Twin head elastic braider (*Textile Machine Works, U.S.A.*)

Round elastic is made by simply passing a number of rubber threads under controlled tension up through the centre of a tubular braider. This work can be produced on any suitable tubular braider and apart from the methods used for maintaining tension on the rubber no alterations to the braider are called for.

2.10. Cable Braiding

The braided covering has been in use in the cable industry for many years and 16 or 24-carrier machines are used mainly for this work. Recently, however, there has been a considerable decline in the use of braided coverings, mainly because of the introduction of synthetic extruded sheaths. To some extent, however, this decline has been offset by increasing demands for glass braided cables and also wire braided coverings for electrical screening purposes. Silk, cotton, rayon, glass jute, linen thread, asbestos, copper and steel wire – all of these materials are in use to provide a braided cover for widely varying types of cable. As an example. Household Lighting Flex. The two cores, one sheathed with red rubber or plastic and the other with black, are usually made in thousand yard lengths. Each length is passed through a braiding machine, generally a 24-carrier bench braider. Covering material is either silk or rayon and irrespective of the colour of the cores the braided sheaths are the same colours. After braiding the cores are paired according to size, one red one black, and each pair is passed through a twinning machine. This machine twists the two cores together. The result is familiar flex used mainly for domestic lighting.

Sometimes circumstances are such that a cable is rubber sheathed, braided and then lead covered in order that the rubber sheath shall remain perfectly shaped during and after the vulcanising process. On completion of vulcanising the lead cover is removed but, of course, processing of this nature is expensive and is avoided whenever possible.

Many problems arise with cable braiding due to the enormous range of sizes and the use of many different materials.

Although 16 and 24-carrier machines predominate in cable work occasionally a 36 or even a 48-carrier braider is encountered. With an increasing demand for wire braiding there is a tendency to use yarn machines running at reduced speed for this work. By fitting wire attachments to the yarn carriers and slowing down by approximately 40 % to 50 % it is possible to produce a reasonable wire braided sheath. If, however, a first class braid is desired it is far better to use a wire braider designed for this type of work.

2.11. Braids

The preceding sections have been devoted mainly to mechanical and constructional aspects of braiding machines of the maypole type. With

ingenuity it seems that there are no limits to the wide variety of plain and fancy plaited work that can be produced.

Simple braid is formed by crossing a number of strands of material diagonally in such a way that each group of strands pass alternately over and under a group of strands laid up in the opposite direction.

Hand plaiting has been in use for centuries but it is only within the last two hundred years that mechanical plaiting has come into general use. Many materials can be used such as cotton, silk, mohair, linen, flax, hemp, jute and more recently plastics, nylon, glass and steel or copper wire.

Three basic styles of braid are in general use:

1. *Flat Braid* in ribbon form.
2. *Round or Tubular Braid* for wire and cable covering, hose reinforcement or protection or solid cords.
3. *Lace* – usually in ribbon form.

The minimum number of threads used are to be found in the Russia braid or Soutache work, these products being used for candlewick and

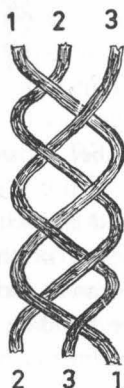


Fig. 28. Three thread Russia braid

coir tresses. Fig. 28 shows diagrammatically a typical three thread Russia braid.

In a regular braid each pair of strands, composed of one or a number of ends of material, passes alternately over and under two strands laid up in the opposite direction and the stitch formation shows two complete double ribs or lines in herringbone formation.

Flat braid is recognised by the number of these lines and Fig. 29 shows such a braid. "L" indicates a line, "S" is a stitch or pick which is the width of the total number of strands on each carrier spool. Plain flat braid is normally composed of an uneven number of strands and it is

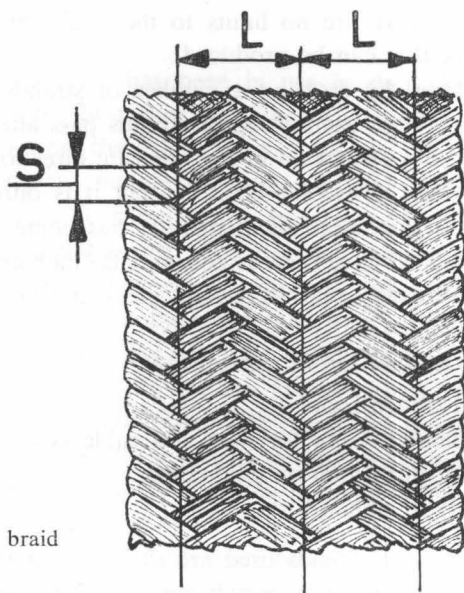


Fig. 29. Flat braid

simple to ascertain how many strands or carriers from the number of lines without having to count the individual ends of material. In a flat braid the total number of strands is equal to four times the number of lines plus one.

Tubular braids are made with an even number of strands and these equal four times the number of lines.

Fig. 30 shows a diamond or basket stitch braid and with this formation each strand passes alternately over and under one of the others. A flat diamond braid consists of an even number of strands and to produce this six horn terminal gears are usually fitted to the braiding machine.

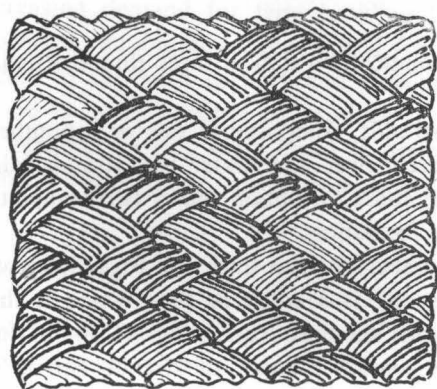


Fig. 30. Diamond or basket braid

A diamond or basket stitch can be produced on a tubular braider simply by removing every alternate carrier. Another method is to run the carriers in pairs i.e. two horn slots loaded and two vacant.

A ribbed effect can be produced on either flat or tubular braiders by the use of warp threads. Fig. 31 shows how to obtain this effect and it is necessary for the machine to be equipped with hollow horngear studs and warp guides.

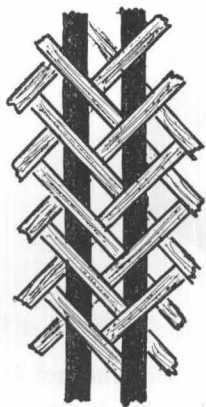


Fig. 31. Warp threads in a regular braid

Rick Rack braid is made on plain flat braiders by graduating carrier tensions on the yarns. Weights or springs are fitted to the carriers so that the light tensions are directly opposite the heavy tensions with gradually increasing or decreasing tensions in between. A special former is necessary for this work and selvedge posts and bars have to be used. The ends of the selvedge bars should be set just above the throat of the former and adjusted so that the strands drop off the ends of the bars at regular intervals. It is an advantage to reduce running speed for this work and some experimenting with positioning of bars and formers is usually required in the interests of a good finish.

Rick-Rack Braid requires fine stitches ranging between 40 and 65 to the inch (Fig. 32). It is quite simple to check the number of stitches per inch because the distance between two points on one side of the braid contains the same number of stitches as there are strands in the braid. Thus if a 21 strand braid measured $1\frac{1}{2}$ " from point to point there will be 42 picks or stitches per inch.

Soutache Braid is a narrow product easily formed into ornamental curves

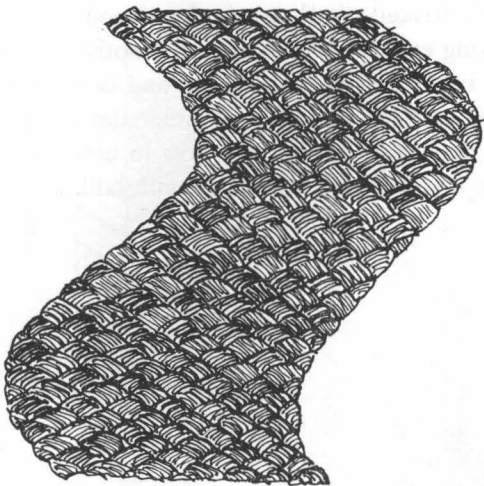


Fig. 32. Rick-rack braid

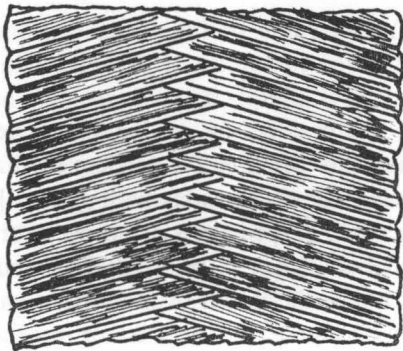


Fig. 33. "Soutache" braid

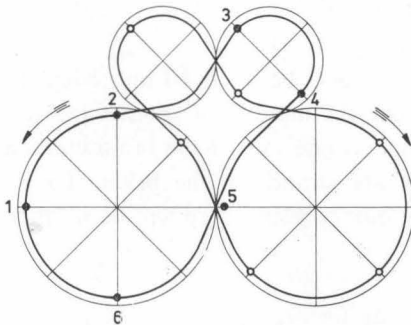


Fig. 34. 6 carrier "Oriental Soutache" set-up

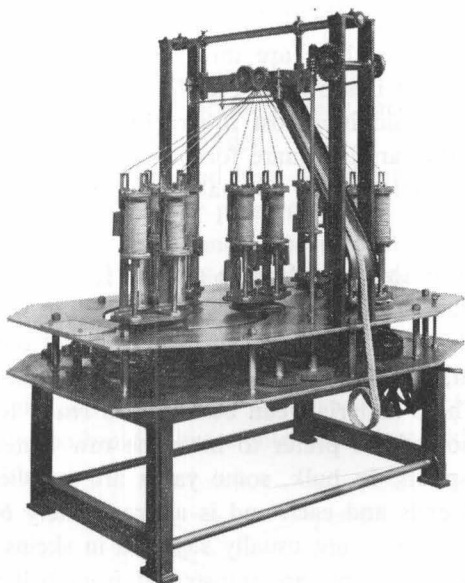


Fig. 35. Plaited "Soutache" braider (*Textile Machine Work, U.S.A.*)

or loops for embroidery and dress trimmings. Variations of the Soutache machine are in general use. Fig. 33 shows a typical braid and Fig. 34 track and carrier dispositions of a six carrier Oriental Soutache machine. A special braider built by Textile Machine Works U.S.A. is shown in Fig. 35. Produced for the manufacture of paper cord or fibre braid a feature of the machine is that each end of material is wound on to a separate spool. Spools are ganged in threes or fours on each carrier base and when in use the carriers are prevented from turning at the track extremities by an eccentric device incorporated in the horngear. The effect of this motion is to produce a plaited soutache and the finished product is used for trimming fibre or reed furnishings.

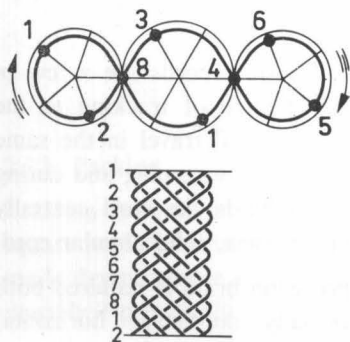


Fig. 36. Set-up for president braid

President Braid – formed with 7, 8, 9, or 12 strands this differs from Soutache in as much as there are three ribs instead of two. A typical track and braid lay-out is shown in Fig. 36.

Square Cord. This braid is almost square in cross section the machine having 4 equal horgears in square formation. Normally warp fillers are used and it is a simple matter to make square elastic on this type of braider.

Shoe Laces. Braid is the main feature of shoe lace manufacture. At one time laces were standard in black, brown or white but with new materials and fashion trends a much greater range of type and colours have to be considered. Rayon, Nylon, Silk, Linen and Cotton are the most commonly used materials. These materials can be obtained ready for use, but large scale producers sometimes prefer to have the raw material in bulk and wind their own spools. In bulk, some yarns are supplied in ball warps consisting of 378 ends and each end is approximately 6000 yards long. Rayon and Silk, however, are usually supplied in skeins. Winding is the first operation and the yarns are transferred from ball warp to braider spools with the aid of a quiller. A quiller has 378 bobbin spindles and is designed to distribute the yarn evenly to the spools. Quillers are economical when feeding large numbers of braiding machines but for small numbers the trend would be to use single or double spooling machines for winding the yarns directly on to braider bobbins. Almost any standard braider, tubular or flat with 16 or more carriers could be used for shoe lace production. Production on either type would vary between 150 and 250 yards per day per machine (maypoles). High speed rotary braiders can be used for circular laces and output in this instance could vary from 400 to 600 yds of braid per day per machine.

Tipping or tag fastening follows the braiding and the machine used for this is fed with braid from a roving can. The braid is measured to the desired length, celluloid, plastic or metal tags are fitted and the laces are then cut and bundled into one gross batches.

Solid Cord Braid: Signal ropes, Sash cords, Curtain cords are a few of the many uses for cord braiding. A different style of tracking to the normal maypole machine is used and the carriers all travel in the same direction. The braid is in the form of a lock stitched wrapping and during manufacture it is pulled through a die which holds the cord centrally against the pull of the carriers thus ensuring an even, solid circular cord.

Hose Braiding: For high pressure hoses a precision braid is required both for re-inforcing and protection and normally multistage horizontal

machines are used for this work. The inner tube of the hose is put to on a mandrel normally about 50 to 60 feet in length. Mandrel and tube are drawn through the braiding heads on a long endless chain haul-off. When braiding is completed tube and braided lining are given another coat of rubber by passing through an extruder.

Still on the mandrel the finished hose is vulcanised and then removed from the mandrel by air or water pressure.

Low pressure hoses are sometimes processed in a similar way without the use of a mandrel and depending upon the specification a number of alternatives can be adopted.

Vienna or Oval Elastic Braid: This type of braid is used for coat loops and undergarments and a machine with special tracking is necessary. Fig. 37. Normally the braider has eighteen carriers and rubber thread is used for warp fillers.

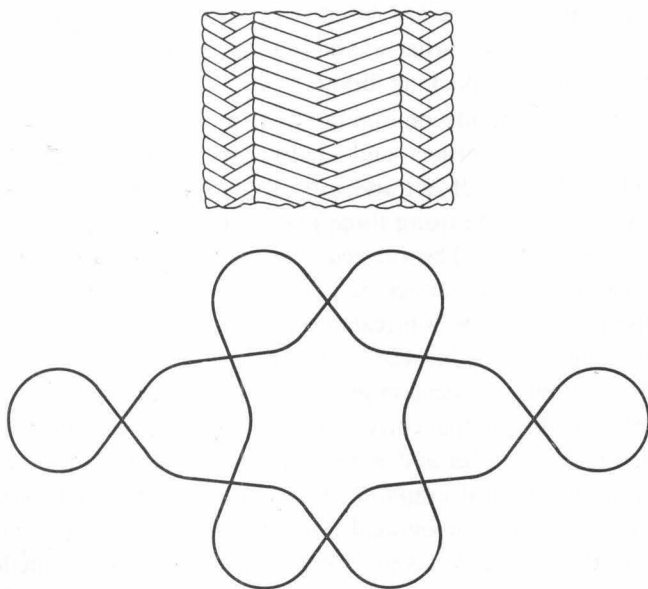


Fig. 37. Tracking diagram for "Vienna" or oval elastic

2.12. Packing

Braiding features prominently in the manufacture of a soft circular or square packing as used for pump glands, stuffing boxes etc. Packings are made dry or grease impregnated and the type of machine used has been described previously.

Materials in general use are flax, jute, cotton, asbestos and sometimes copper. Flax packing is usually made on eight carrier machines and the finished product is square in section with a regular stitch of one over and under two.

Sizes vary from $1\frac{1}{8}'' \times 1\frac{1}{8}''$ to $2\frac{1}{2}'' \times 2\frac{1}{2}''$ and long line flax or unadulterated flax tow roving is commonly in use.

The difference in these materials lies in the length of the staple yarn, the long line flax having a length of from 18'' to 22'' while the tow roving varies in length from 8'' to 12''.

Packings are made by using the correct number of plies of yarn on each braider carrier. The plies are twisted on a forming machine, each half of the material having a right or left hand twist. The yarns are then arranged on the carriers in such a manner that twist will be reduced to a minimum during the braiding operation. The number of plies varies with the size of the packing and ranges from one to fifty two.

Square packing braiders are fitted with corner and centre tubes. For this purpose a two ply carpet chain is used with as many ends as are needed to fill out the packing braid.

Jute packings are made on similar lines to flax and sizes range from $\frac{3}{16}''$ to $1\frac{1}{2}''$ square. Corners and centres are normally used, plies are twisted half right and half left and a 65 lb roving is usual practice. A $\frac{1}{2}''$ jute braid could be made using three ply on the carriers and two ply, two ends up in the corners. The lubricant impregnated in packings depends upon the nature of the service required of the packing. A solid braid of long line flax could be lubricated with 100 % pure molten tallow or alternatively this could be 80 % Vacgrease and 20 % pure tallow. Lubricants are generally heat impregnated and sufficient time is allowed for packings to absorb the correct amount. Certain packings are afterwards rolled to correct size and waterproof hydraulic packings are finished off with an application of graphite. With cotton braid packings for use in connection with ammonia or acids, the yarn is soaked in cylinder oil, drained, run through fine flaked graphite, twisted on a former and then braided. Copper wire and a number of semi-metallic packing combinations of asbestos and lead, babbitt or copper are normally made on eight carrier square packing braiders.

A wide variety of braids are used in the millinery trade and materials such as visca, horsehair (artificial) rayon, wool, cotton, artificial silk etc. are all in use. Braids are from 2.5'' to 6'' wide and usually consist of plain, diamond, hercules or combination stitches. Artificial horsehair is used with a regular stitch and open braided over selvedge wires with a

selvage warp thread to hold the braiding in place. Wide millinery braiding is often a diamond stitch of strip material up to 4" wide. The finished braid being anything up to 6" wide.

Single ligne braids have numerous applications and a considerable quantity of candle-wick is produced on three carrier braiders. It is normally manufactured with a suitable number of parallel ends per thread and is termed 27 or 36 end wick according to the number of yarn ends used in the making.

Rag-Rug braids are examples of single ligne made of three, five, or seven ends to imitate hand made rugs.

Rags, chenille, wool, slasher cuttings, blanket strips, burlap, and knitted tubing have all been successfully braided for rug making. Another use for single three thread ligne is leather braid used for shoe trimmings, sandals, handbags etc.

Strip materials used for these braids usually have a right and a wrong side for working and the machines have to be fitted with special attachments to ensure that the strips do not turnover.

2.13. High Speed Braiders

Due to the serpent like contour of carrier tracking, together with centrifugal forces and general vibration when braiders are running it has been almost impossible to affect any marked increase in running speeds of maypole machines.

Spring tensioning for carriers and modern constructional materials and methods have improved performance but it seems that the maypole machine is destined to remain a comparatively slow running but extremely useful piece of apparatus.

In recent years, however, a new type of braider has appeared. Suitable for tubular and solid cord work these high speed rotary braiders are approximately three times as fast as the conventional maypole braider and usually they are quieter in operation. Anyone who has visited a large braiding establishment will appreciate the value of a reduction in noise. It should be emphasised that this type of braider is at present limited to the production of solid cords, shoe laces and the rapid sheathing of wires or cable.

The sinuous tracking of the maypole braider has been superseded by an intermittent circular tracking. Braid is not formed solely by carrier motion as on the maypole machine.

Carrier motion is orbital and we have two sets of carriers rotating in

opposite directions, and the yarns or wires are deflected or guided to form a braid. Deflection is by a combination of carrier shape, rocker arms and deflector plates or as in the American "Wardwellian" rapid braider by carrier shape and fixed guides.

Due to the increase in running speeds, it has been necessary to incorporate a braking system to stop the machine quickly in the event of a broken yarn. Automatic traverse gear and slipping drives for reception reels are essential to these machines and these very necessary refinements tend to make high speed braiders complicated and expensive.

Cleanliness and prompt attention to any slight defects are essential for the successful working of these machines. Quality of the braiding materials has to be considered carefully although instances have been known where flimsy yarn that could not be used on maypole braiders was disposed of without difficulty on these fast machines.

A short description of the most familiar of these machines will follow.

German "Tober" Braiding System

Prior to 1946 this type of braider was produced by Froitzheim and Rudert of Berlin in standard ranges of 12, 16, 24, 36 and 48 carrier machines.

Basically the braider consists of a central or inner driving ring the function of which is carrier propulsion. An elaborate outer frame on which

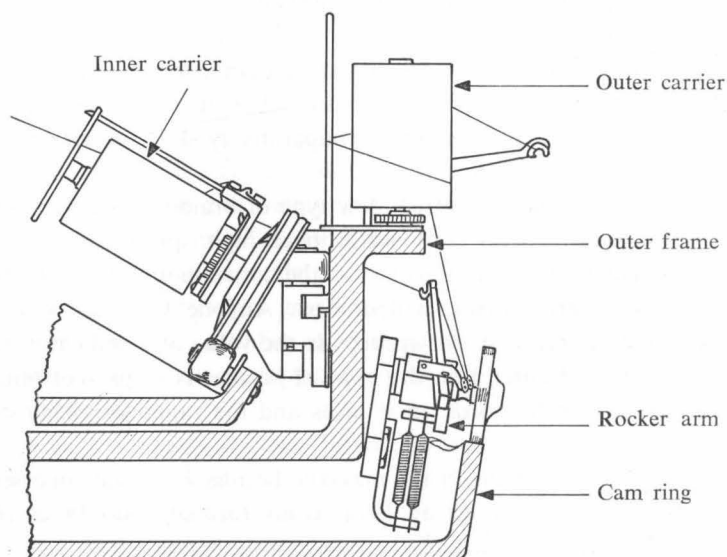


Fig. 38. "Tober" high speed braider

are mounted the outer carriers, rocker arms and deflection guides rotates in the reverse direction to the central driving ring. In addition the tracking for inner carriers forms part of this frame. Rocker arms which are spring loaded and actuated by a cam ring, oscillate when the machine is in motion, thus placing the yarns or wire alternately over and under each pair of inner carriers. Deflector plates are fitted to the periphery of the inner driving ring and attached to each deflector plate are two rollers, one of polished steel and the other of fibrous material.

The inner carriers are fitted with pigskin tyred light alloy discs and propelled by the pressure of the polished steel roller (Fig. 38).

Yarns or wires from the outer carriers are rolled between the polished steel roller and pigskin tyre on the light alloy carrier disc.

A novel feature of the inner carriers is that advantage is taken of the centrifugal pressure created by the rapid movement of the inner carriers to reduce pressure exerted on the carrier disc by the driving roller. The inner carrier base is made in two halves, the bottom half of which is a sliding fit on the outer tracking. The top half carrying the tyred disc, supply system, spool and deflector is fitted to the bottom half so that a restricted amount of float is permitted. When the braider is running at speed, centrifugal force lifts the top half of the carrier and permits the passage of yarns between the driving roller and the carrier disc with a minimum of pressure thus avoiding any tendency for yarns to drag or break.

Quiet in operation, a disadvantage associated with this braider was the tendency for some of the many ball races used in the construction of carriers, rollers, etc, to become choked with fly, thereby causing frequent stoppages with broken yarns.

Another high speed braider of unusual design is the Guido Horn type of solid cord machine. Produced in Germany until recently this braider is seldom seen in use today.

A set of inner and outer carriers rotate in opposite directions and a novel method of carrier propulsion and yarn deflection is used.

Mounted on a hollow spindle situated above each lower spool carrier is a spur gear resting in a circular rack circumscribing the machine.

A thread guide is accurately positioned in the web of each gear and the yarn supply is drawn from the lower carrier, pulled through the hollow gear spindle and then through the thread guide in the gear web. From Fig. 39 it is evident that the rotating spur wheel will pass yarns from the lower carriers over and under inner carriers going in the opposite direction thus forming braid.

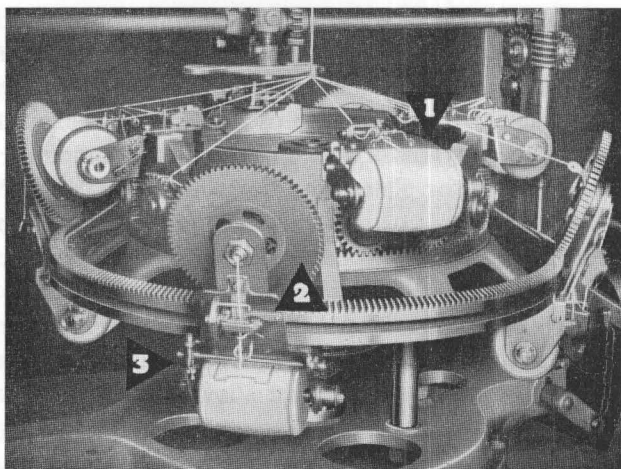


Fig. 39. Yarn deflection (high speed braiders) (*P. Hodges, Nottingham, England*)

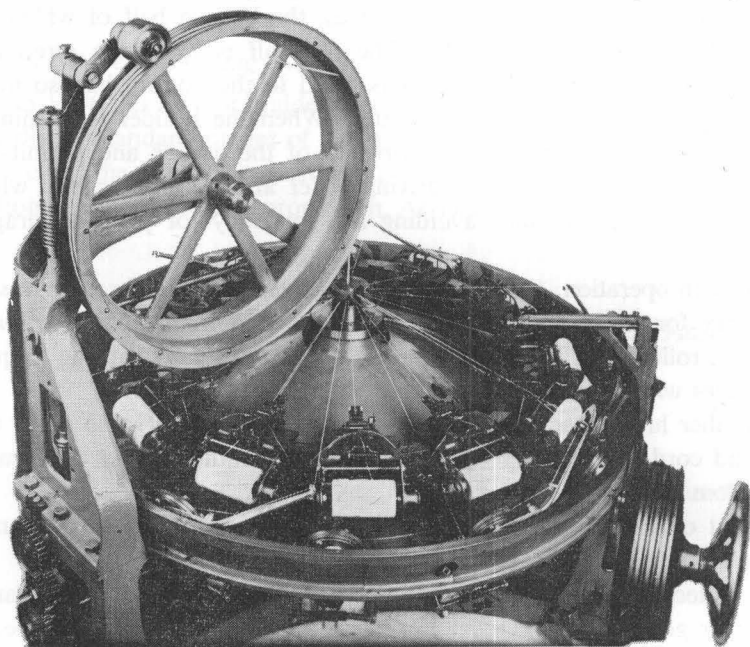


Fig. 40. "Horn" type high speed braider (*Th. Spirka K.G., Germany*)

A1 : 1 braid will be produced on the machine illustrated and by varying the number of carriers used a 1 : 1, 1 : 2 or 1 : 3 braid can be produced. It is not possible to add or subtract carriers on the same machine, the braider must be built for the braid formation required.

attention is drawn to the coding system used. This coding simplifies the ordering of spare parts and advantage will be taken of this when describing some of the mechanical features of this novel braider.

With the exception of the upper carriers a fixed system of yarn or wire deflection is used.

Upper carrier propulsion is ingenious and a section of driver and Track plate is shown in Fig. 42. Slots are machined in the cast iron driverplate

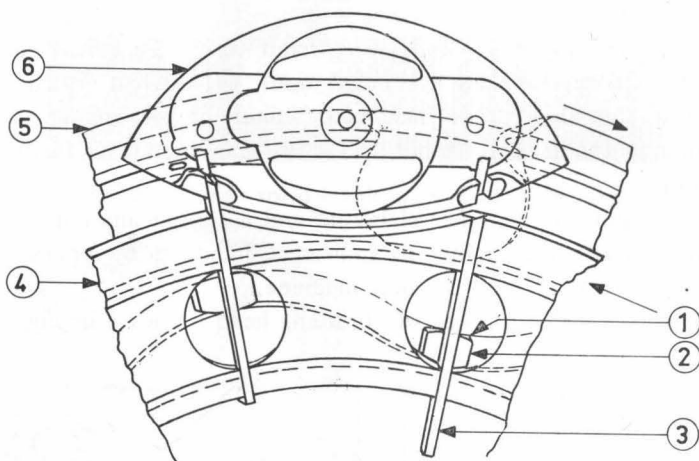


Fig. 42. Carrier propulsion "Wardwellian" (*Wardwell Braiding Machine Co., U.S.A.*)

24-3 AX-two for each upper carrier. Hardened steel carrier drivers are fitted to the slots R.H. 16-798 and L.H. 16-799 for each upper carrier.

When working, these carrier drivers are given a reciprocating motion, and studying the diagram it will be observed that as one carrier driver is engaged in the upper carrier slot, the other carrier driver is withdrawn to allow the wire or yarn supply from the lower carrier to enter or leave the narrow gap between the side of the upper carrier and the scallop in the driver plate. Splash feed lubrication is used internally and careful attention should be given to instructions issued by the manufacturers for daily lubrication.

An exclusive feature of this braider is accessibility inasmuch as the braiding head can be dismantled, cleaned, adjusted, and supplied with fresh oil in a very short time, the only tools required are a stout screw driver and a shifting spanner.

The standard machine is 16 carrier but 12, 24 carrier or double decker machines are readily obtainable.

The Tubular Knitting Machine

In connection with wire and cable covering a new approach has been made regarding the vexing question of output.

This has been brought about by the introduction of the high speed knitting machine. Speed is certainly an advantage with this machine but so far the knitted sheath has been limited to certain types of wire and cable covering.

The conventional braiding process, even when high speed braiders are used is slow when compared with associated processes and manufacturers are forever seeking to improve outputs or alternatively dispense with braiding whenever possible.

Increased output, silent operation, and reduced winding costs are claimed for the knitter, which as yet cannot be classed as a general purpose machine, but further developments should be both possible and interesting.

Most of the pioneer work on this form of covering seems to be confined to America (Fidelity Machine Co.) but the English firm of B. & F. Carter of Bolton have introduced the "Braidex" a two head vertical machine for the production of knitted covers.

The American machine, known as the "Sinfra" is a horizontal machine obtainable with from one to four heads as desired. Features of these machines will be described later.

SOME PROBLEMS ASSOCIATED WITH CARE AND OPERATION OF MAYPOLE BRAIDERS

Maypole braiders vary considerably in design and type and this diversity seems largely due to the country of origin. English and American design favours the slide plate braider whereas many European machines are of the carried carrier type. When a machine is new, mechanical troubles are rare, providing the ordinary routine of cleanliness and regular lubrication is observed. Difficulties are more frequently encountered with maladjustments and faulty spools. A poorly wound spool or even a spool wound with too long a traverse can give rise to many frustrating stops.

The majority of yarn spools in use on braiding machines are simply cardboard tubes with the requisite amount of yarn wave wound on to the tube. Spools with tapered ends will sometimes cause frequent stoppage through loose turns falling to the bottom of the tube and pulling taut-breaking the yarn and thereby stopping the machine.

One way of overcoming this nuisance is to lightly smear with the finger some quick drying adhesive down each side of the tapered ends. This effectively holds any loose turns in position until the spool is empty.

Ballooning is another common trouble associated with maypole braiders. This term is used to describe erratic paying out of yarns from the carriers and is readily visible as one or more loose, snaking yarns in an otherwise taut cone of yarns when the braider is working. A slightly bent carrier tension post, a weak or foul tension spring, or badly fitted spool or cop holder. These are probable causes of individual yarn ballooning. Excessive running speed will cause general ballooning. If the machine is operated at too high a speed the carrier droppers cannot function properly and sporadic ballooning occurs with all the yarns. Spring tensioning of carriers has reduced the tendency for ballooning but it will occur if machines are running at speeds above the makers rating. The older style of braider with weighted carrier droppers produces a superior braid but speeds are severely restricted.

Careful attention should be given to all carriers and any faults should be rectified without delay.

Sometimes machines will have to remain idle for long periods and when this occurs, carriers and decks should be cleaned and then covered up.

Slightly rusty thread guides can be a diabolical and often undetected

source of stoppages, especially if the guides have been deeply grooved by the continual passage of yarns.

Running faults are usually of a simple nature, varied in character but not always easy to locate. Quite often a poorly wound spool will be mounted on one of the carriers to become an obscure cause of irritating delays and inferior braid.

Carriers should always be maintained in a reasonably clean condition and before starting a production run it is policy to remedy any minor defects noticed when setting up. A slightly bent or burred spool pillar, a worn supply ratchet, a weak tension spring or a dropper that is inclined to stick at odd times, any of these apparently insignificant faults could be responsible for a considerable waste of time if not quickly located and remedied.

All working parts of a carrier requiring oil should be treated with the utmost discretion. Too much oil incurs the risk of a soiled product and conversely a shortage of lubrication will create harsh and erratic working effects on the yarn or wire supply system.

A simple method of determining whether or not carriers are in reasonable working condition can be used when setting up a small or medium sized braider. Pass all yarns from the carriers through the braiding die or centre, bunch them together and making sure that all yarns are firmly in the hand, pull them steadily upwards for about twelve inches before securing the ends to the capstan. If any yarns break or cannot be pulled upwards a check should be made for carrier faults.

A similar test can be made on a wire braider but in this instance the change gears should be separated and the bunched wires should be secured to the capstan after passing them through the braiding die or centre. It will be found that it is easy to pull them smoothly through the braiding centre simply by turning the capstan, providing of course that all the carriers are in reasonable condition.

When a braiding machine has been in use for long periods it sometimes happens that one of the carrier track followers becomes worn short. With a carrier in this condition tracking may be damaged and in extreme cases the worn carrier will sometimes turn into the wrong track and the machine will become locked.

Service mechanics have been known to extract a carrier with a worn follower and re-insert in the braider the reverse way round in order to keep the machine in service. This practice is deplorable because with an odd carrier the wrong way round the result appears immediately as a slight gap or irregular braid formation.

Another and more insidious type of fault can also be caused by a badly worn carrier. The symptoms are that the machine stops at all sorts of times, sometimes running for five minutes, sometimes for one hour.

When confronted with this type of stoppage the ordinary operator is usually puzzled because there is no visible reason for the stoppages.

Trouble of this nature is usually associated with machines that have been in service for a long time and is due in the majority of instances to a combination of well worn tracking and a badly worn carrier. Fig. 43.

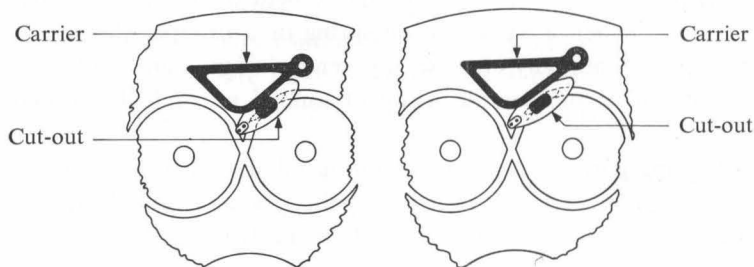


Fig. 43. Worn carriers and track effect

When a carrier is well worn and becomes a very sloppy fit in the tracking, the body of the carrier base lightly knocks the trip lever every time it passes. To correctly diagnose a fault of this description rest two fingers lightly on the back of the cut-out lever and set the braider in motion.

The worn carrier will be felt as a light regular knock on the cut-out lever at each convolution. It is this continual knocking that eventually stops the braider. Having detected a faulty carrier the next step is to find it. This can best be located by rocking each carrier in turn until one is found that is excessively slack in the tracking when compared with the remainder. This carrier should be marked and removed from the machine for examination.

If the track follower is found to be badly worn or very short the carrier should be broken up and a new one fitted.

A good example of what is being done to prolong the working life of tracking systems is the recent development by new England Butt Co. U.S.A. For arduous conditions they have introduced a jigmilled track plate that is double the normal thickness. This new track plate is standard except for thickness and it is therefore comparatively easy to adapt the new style tracking to existing machines. It is claimed that the working life of the new tracking is from three to four times that of the old style tracking. Due to the tortuous nature of tracking systems, the unbalanced nature of the loading and forces that come into play under working

conditions, coupled with the abrasive nature of some of the braiding materials it is a credit to the manufacturers of these machines that tracking systems last as long as they do.

An important feature of all braiding machines is the stopping mechanism. This is usually a simple system of latched levers designed to bring the machine to a standstill in the event of broken yarn or wire.

Due largely to the peculiar nature of braiding it is almost impossible to find a stopping gear that is completely successful. In fact under certain conditions a strong broken yarn or wire will sometimes foul the carrier tensioning and prevent the functioning of the trip gear.

In simple form the mechanism for stopping the braider consists of a suitably shaped lever linked with the driving clutch. When the machine is working the shaped lever is held clear of the carriers by some form of latch. If a yarn or wire breaks, the carrier slider or drop weight falls to the bottom of the tension stand and with the dropper in this position the carrier travels round the track until it reaches one of the shaped levers. The dropper strikes the shaped lever and this in turn disengages the driving clutch, thus stopping the machine.

For machines with a large number of carriers, stopping levers are duplicated at suitable intervals round the tracking and in some instances the levers are coupled by means of a ring (Fig. 44). By duplicating these

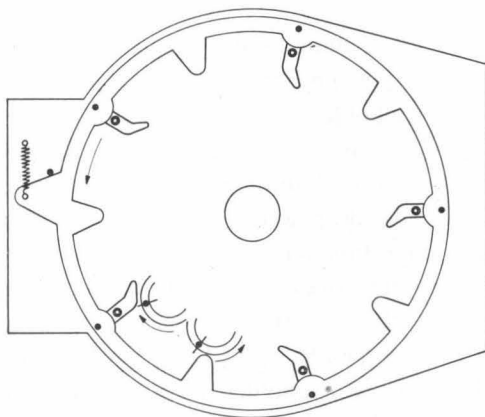


Fig. 44. Duplication of stopping levers

levers there is less chance of faulty braid. For example, a yarn breaks on a braider with only one stopping lever immediately after the carrier has passed the trip. Under these circumstances a complete convolution

will be made by the carrier before the braider stops and this gives sufficient time for the broken yarn to ruin the appearance of the braid.

The remedy for a mishap like this is to turn the braider back by hand until the braid disfigurement has been cleared and then re-insert the broken yarn. Care is needed when winding back to take up all the slack yarns by lifting each spool clear of the supply pawl and winding the yarn on to the spool until it is taut.

Care is necessary when setting stopping levers because clearances are small and maladjustment may mean the production of long lengths of braid with one or several threads missing. If the trip mechanism is in good order it is impossible to start the braider with one of the yarns or wires not threaded up. Sometimes, however, particularly if carrier thread guides are badly worn or inferior yarns are being used, untidy braid will be produced for a considerable running period and the trip gear will not function.

For example, assume that a five end yarn is in use and after running for a short period, an end breaks on one of the carriers. The remaining four ends will keep the carrier functioning for some time, but one end will be drawn into the braid as a fault. The other loose end pays out with the remaining four ends running from the carrier until there is sufficient entanglement of yarn to break the remaining four ends, or as sometimes happens, another carrier is fouled – all five ends break and the machine stops.

To prevent this sort of thing, worn thread guides should be renewed, spools must be properly wound and the use of inferior yarns avoided.

Sticky spools or copholders are another source of trouble. Fly gets wrapped round the spool pillar or the pillar is accidentally bent or burred or the copholder is distorted through careless handling. Symptoms are usually the same i.e. the drop weight is pulled to the top of the tension post, the spring cannot function and the copholder rotated in a jerky manner or else it does not rotate at all and the yarn breaks. An experienced operator will avoid this sort of trouble by making sure that every freshly fitted spool or copholder spins freely on the carrier spool post.

When a fresh spool or copholder is in position on the carrier the dropper should be lifted to the limit of the tension guide rod. In this position the spool should spin freely on the carrier spool pillar.

Two styles of carrier tensioning are in general use – variable or adjustable and fixed. With fixed tensioning, springs have to be changed to suit the braiding material and the advantage of this system is that tensioning maladjustment by inexperienced operators is avoided.

Many modern carriers are fitted with easily varied tensioning devices in order to dispense with the necessity of frequent spring changing. This is useful when operators are sufficiently skilled to judge the tension required.

When large numbers of manypole braiders are in use it seems that the favoured solution to the tensioning problem is to use carriers with readily interchangeable springs.

A very efficient carrier of this type is the "Mosspeed" produced by the Mossberg Pressed Steel Corporation, U.S.A.

To change springs on this type of carrier is a very simple operation and tools are not required.

From Fig. 45 showing the top of the carrier tension post it will be

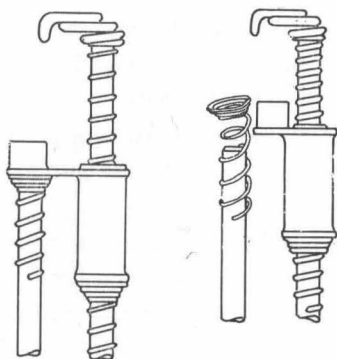


Fig. 45. Tension spring changing
(Mosspeed carrier)

seen that the spring loaded clamping bar at the top of the two tension guide rods is lifted and turned to one side. The existing spring is removed and the heavier or lighter substitute is slipped on to the tension rod and the clamping bar replaced.

With Ric-Rak braid a wide range of springs would be required for carriers of this type but once fitted no further adjustment is needed.

Improvements in carrier design appear from time to time but the problem of a carrier that will accommodate a large supply of yarn, operate at high speed and provide a uniform yarn release is forever with the braiding machine designer.

Examination of a maypole braider track shows that the distance from the top thread guide on the carrier to the braid centre is alternating from short to long and long to short as the carrier follows the serpent like track round the braid centre.

This carrier swinging from one extreme to the other does not make for a uniformly tensioned yarn release. The normal method of providing

for these carrier alternations is to allow for a surplus of yarn in the form of a loop. The loop being tension controlled by means of a spring loaded or weighted dropper.

This system works quite well, but imposes a definite limit on running speeds. If carrier movement is too rapid the dropper cannot function quickly enough to maintain a reasonably consistent tension. It was this variation in tensioning conditions that induced Taylor to design a braider with the track plate in the form of a tubular strip thus keeping the carriers at a reasonably uniform distance from the braid centre. Although this helped to solve the tensioning problem the running speed of the braider was nevertheless limited by other mechanical complications. These limitations were the subject of discussions in Germany in 1885 and as early as 1866 a British Patent specification appeared with details of a machine for overcoming these problems. Early in the present century, however, a number of solutions to the problems appeared and the future of the high speed tubular rotary braider was established.

Dropweight or Gravity tensioning on carriers is ideal when running speeds are low and for the production of certain fancy braids with delicate yarns this system is still in use today.

Almost without exception the carrier path on maypole braiders is of circular formation and when the machine is in motion, centrifugal forces (C.F.) are generated which have a direct effect on the rise and fall of the tensioning weight. C.F. is proportional to the square of the speed i.e. if the speed is doubled we increase the C.F. by four times and from this it must be evident that the use of dropweight tensioning severely restricts the running speed of the braider.

The majority of modern production braiders are fitted with spring tensioned carriers thus rendering the use of a heavy dropper unnecessary and this considerably reduces the effects of C.F.

With the use of suspended weights, tension is more or less constant during the braiding operation, whereas in the case of spring tensioning the tension varies from minimum to maximum, when the bobbin or cop is released. At one time this constituted the main objection to spring loaded carriers although there is no doubt that the suspended weight tensioning is superior.

It is generally acknowledged that there is very little, if any difference in the quality or appearance of standard braids produced in a modern machine equipped with spring loaded carriers.

It must be emphasised that no matter what type of carrier is in use

it is important that the yarn should be threaded up on the carrier correctly.

All the makers of braiding machinery mentioned in this publication supply information and diagrams showing correct procedure, but even so there are instances where these instructions have been disregarded with inferior braid or stoppages as a result.

When carriers are fitted with copholders it is normal practice for the yarn to be supplied ready wound on a cardboard tube.

Cop-holders vary in design, some having a plain ribbed tubular centre, others are fitted with balloon spring sleeve or as in the case of the Carter Rol-holder (Fig. 46) just a plain tube with a rubber ring that rolls down the tube.

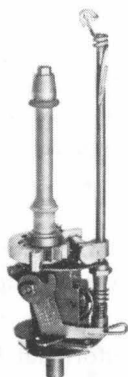


Fig. 46. Rol-holder (Cops) (*B. & F. Carter, Bolton, England*)

Whatever type of cop-holder is used the cardboard tubular centre of the spool must be firm fit on the copholder.

If for any reason the cardboard centre should become slack on the copholder through damage or weakness frequent stoppages will occur.

Recommended spool sizes should also be adhered to and often trouble is experienced solely because spools that are oversize have been used with the idea that longer runs are possible.

It is seldom that a well cared for braiding machine has to be dismantled but should an emergency of this nature arise usually through trouble with horngears much care and patience are needed. Quoits and horngears (slide plate machine) or horngears and bearings (carried carrier machine) should be clearly marked before dismantling is attempted.

After prolonged running, horns slots, gears, and tracking are all blended and unless care is exercised during re-assembly to return all these working parts in correct sequence it will be difficult if not impossible to obtain smooth running.

For example, if through damage or seizure, one of the horn gears has to be removed and a new one fitted it will be found that the horns slots of the new gear will not line up with the well worn slots of the adjacent gear.

This will mean that either a complete new set of horn gears will have to be fitted or the slots in the replaced horn gear will have to be blended until carrier transfer on this section is smooth. In effect the newly fitted horn gear will need the slots to be filed or ground until they are in the same worn out condition as the adjacent horn gears. This, of course, is not in keeping with good engineering practice but it is possible in this somewhat crude manner to prolong the working life of the braider for a considerable period. When replacing a set of horn gears, slots should be carefully lined up with a turning pressure applied to the gear train making quite sure that the pressure is applied to coincide with the direction of rotation. Due mainly to gear backlash it is possible to replace horn gears in such a manner that when the final gear is inserted there will be an error in positioning of one tooth. This is the reason for pressure loading the gears as they are replaced. Systematic attention and early replacement of worn parts are necessary if maintenance costs are to be kept to a reasonable level. If a braider is neglected it will eventually be found that all the working surfaces, bearings etc. will have become worn and in this condition it will be impossible to replace an individual item without upsetting the remainder.

Running speeds are forever a source of controversy and unfortunately there are always production people who think that output is mainly a question of convolutions per minute.

At one time the trend was to run a braider at one fixed speed regardless of conditions or materials, but nowadays there is an increasing tendency to include some form of variable speed gear in the driving equipment. This is an important improvement because there are many new synthetic materials suitable for braiding and speeds have to be adjusted to suit these materials. General experience has shown that for general purposes a good all round economical speed is usually slightly below the makers recommendations.

This is not, however, a reflection on the machine manufacturer because the majority of braiders will run satisfactorily at recommended speeds if kept in good working condition.

When, however, large numbers of machines are in use and this is generally the case where braiders are concerned it is not an easy matter to maintain all the machines in first class condition. Thus by slightly

lowering the running speed there is less wear and tear, fewer stoppages and in many cases an increase in output.

The governing figure with output is usually stitches or picks per inch in the case of flat braids or with tubular work. The lay is the distance travelled by the finished product during one complete convolution of any one carrier.

It is quite a simple matter to measure the lay when yarns are in use. When starting a braid there is usually no objection to soiling the product for an inch or two, so with dirty fingers, smear one of the yarns from the carriers between the carrier top thread outlet and the braid centre.

Start the braider and run for a few inches of braid.

The dirty thread will be clearly visible in the finished product where it can readily be measured. (Fig. 47).

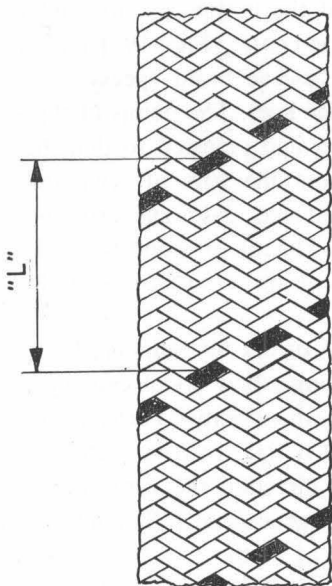


Fig. 47. Lays

This procedure cannot generally be used where wire is concerned because in most cases it is not so amenable to marking.

Assuming that single wires are used for the braid the easiest method of checking the lay is the pitch distance of wires laid in the same direction. Thus for a sixteen carrier machine the lay would be the pitch distance between eight wires or for a twenty four carrier machine, this would be the pitch distance between twelve wires. Usually with very fine wires a loupe or magnifying glass would have to be used to count the wires with a ruler laid on the braid.

With flat braids there are so many variables to be considered that it is usually better to conduct a few trials on the braider until the desired effect is produced. Fine or coarse yarns, close or open stitches, shape of former, adjustment of selvage bars, light or heavy tensions, rate of feed, any of these can have an effect on the finished product.

Subject to these variations the width of flat braiding is limited by the number of carriers in the machine.

Thus for flat braids up to about $\frac{3}{8}$ " of an inch wide a 17 carrier machine would be used, whereas for a 1" strip a 49 carrier braider would be called for. These figures are quoted as a rough guide for standard yarns.

For machines with 25 or more carriers it is usually advisable to use selvage bars. These bars are long pointed steel needles extending from selvage posts fitted to two or more of the horn gear studs and reaching to the throat of the braiding former or centre. Fig. 19 Page 12 shows clearly how bars are arranged. For Ric-Rac braid special formers are required and it is essential to use selvage bars. The points of the selvage bars should be set just above the former and adjusted so that the strands drop with a slight plucking action from the bars at regular intervals. The speed of the machine has to be reduced and some experimenting is usually necessary to obtain correct adjustment for good work. A variety of patterns can be produced simply by using different coloured yarns or varying materials.

Attention to detail is essential for the successful running of any type of braider. Even the insertion of yarn from a new spool can be the cause of untidy braid if the yarn is laid in incorrectly. Yarns from carriers running in a clockwise direction should be laid in from right to left, and with carriers travelling in the opposite direction the yarn should be laid from left to right. Failure to observe this procedure will result in unsightly braiding.

Occasionally a braider will stop frequently with a single broken yarn and when this happens, the carrier should be marked in some way. Keep the braider working under observation and if on each stoppage the broken yarn is associated with the marked carrier it is almost certain that either the spool or carrier is faulty.

A worn ratchet or pawl, a weak or fly choked tension spring, or a spool of yarn that is not firmly mounted on the copholder, any of these faults will cause broken yarns.

There is a tendency for certain yarns to be made with low twist and when a braider is working one half of the carriers will tend to increase

the twist slightly, whereas the other half of the carriers will produce the opposite effect. Thus it will be observed that stoppages are likely to be frequent if weak low twist yarns are in use.

Given normal care and attention, the majority of braiding machines will run satisfactorily for many years. With the older type of slide-plate braider, however, trouble is sometimes encountered with horngears and horngear studs. Normally oil is fed to the hornear pin via a small counter-sunk hole in the quoit plate, but should the oil hole become choked with fly, and this is often the case when large numbers of machines are in use there is always the danger that the bearing surfaces will become dry and seizure will result. In cases of this description strenuous attempts should be made to lubricate the seized bearing sufficiently to enable the machine to be turned by hand for carrier removal. Failure to remove the carriers will mean that the deck will have to be completely dismantled unless the seized gear is located in such a position, that it is possible to clear the affected quoit by removing three or four carriers. To dismantle even a small braider deck is a difficult business unless the carriers are first removed.

It is so easy to check on whether or not this vital oil service is in good working order. With the aid of a suitable piece of wire remove any fly or fluff that has accumulated in the oil holes. Flood each oil hole in turn with fresh oil and then turn the braider by hand. If conditions are normal the oil will quickly disappear.

An insidious form of trouble, although rare is sometimes encountered with the older type of braider. This is the badly worn horngear pin or bush and the danger lies in the fact that symptoms of the trouble do not become apparent until considerable damage has been done. Usually by the time trouble shows up heavy track wear, and partial destruction of several horngears and slots will have taken place.

When re-assembling decks or fitting new track plates it is essential to line up and level the track plates with extreme care, especially at the crossings. A burr or a very slightly bent horngear pin will be quite sufficient to cause carrier jamming in this particular region.

Although it is sometimes possible to run a braider with tight spots in the tracking, a heavy and irregular load will be imposed upon the driving gears, and this will result in a permanently damaged and in most cases an extremely noisy machine.

3.1. Maypole Braiders for wire

In recent years there has been a marked increase in the demands for

metallic braid for hoses, and also cable sheaths, sometimes for a protective flexible covering, but mainly for electrical screening.

It is possible to produce a limited range of fine wire braids on a yarn braider running at reduced speed but unless great care is exercised the results are inferior to similar products made on a well designed wire braider. Carriers for wire braiders are of necessity rigidly constructed and in most cases spools are mounted horizontally in the carrier. The main reason for this method of spool mounting is the avoidance of dropped turns. With a vertically mounted wire spool there is always a tendency for turns of wire on the outer layer to open slightly and slip down over adjacent turns.

This inevitably creates a locked or foul turn, the spool cannot rotate and a broken wire is usually the result.

Partly due to the nature of the material, but mainly because of the overall weights of carrier and wire, running speeds of wire braiders are considerably lower than those of an equivalent yarn machine. A typical wire carrier is shown in Fig. 48.

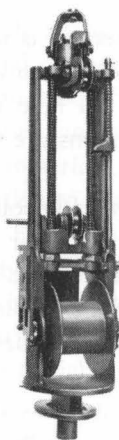


Fig. 48. Wire carrier (*N. E. Butt Co., U.S.A.*)

Clean design, rigid construction, and accessibility are feature of this carrier which is of American origin. Ratchet supply release and spring tensioning are used with the carrier and it will be observed that the familiar thread guides used for yarn have been dispensed with in favour of V groove pulleys. The top wire outlet is a combination of a swivelling pulley and a floating stirrup. Wire lacks the flexibility associated with the majority of yarns and also it is inadvisable to pull or bend the wire round the small radii normally used where yarn carrier thread guides are concerned. (Fig. 49).

Where coated wires are used for braid, and in the cable industry it is common place to braid with tinned copper or nickel plated copper wires, it is essential to use carriers with pulley guides.

Fairly heavy carrier tensioning has to be used for wire and to drag coated wires under this sort of tension and over fixed guides would ruin the outer skin of nickel or tin in a very short time.

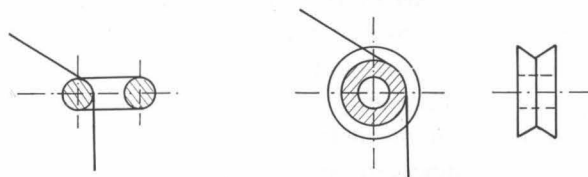


Fig. 49. Wire guides

As soon as we turn our attention to metallic braiding we are immediately confronted with an important but often neglected prerequisite—spool winding.

Evenly tensioned, multi-end spool winding is a formidable problem and it is only in recent years that any serious attention has been devoted to this extremely important preliminary.

One, two, or three ends of wire can be wound on a single spool with conventional winding gear and reasonable results will be possible if care is taken. With braiding however it is common place to use five, six, eight and sometimes twelve ends for the braid and with five or more ends to contend with it is extremely difficult to obtain good results with normal winding gears.

The term “end” means a single strand of wire regardless of the length. Great care is needed when commencing to wind a spool of wire, because if as is often the case, crossed turns and knots are made with starting turns it will become almost impossible to complete the winding in a satisfactory manner. Spool winding gears should be designed for gradual starting. A quick start, or a sudden snatch will cause trouble and in the case of fine wires it may cause breakages. Good, true running spools are essential and equally important, well balanced supply reels (let-off) should be used. When it is considered that a fully loaded supply reel may weigh anything between seven and one hundred pounds, any out of balance due to damaged reel flanges, or bad winding can have adverse effects when trying to maintain uniform tensions on the wires. Some form of braking will also have to be used with the supply reels, the brakes being automatically applied when winding stops.

If the supply reels are allowed to overrun, a crop of loose turns will have to be sorted out before the next braider spool can be wound.

In the interest of good braiding, the spools should be reasonably uniform in weight. An ideal method would be to use a wire winder fitted with a turn counter and using the first spool as a minimum, increase the number of turns on each succeeding spool.

As an example, wind a set of 16 spools starting with a minimum and increasing the number of turns by 5 for each successive spool. By winding spools in this manner it is possible to avoid the hazard of having several spools running out simultaneously on the braider.

With spool winding for maypole braiders it is possible that some of the lesser faults in winding can be overlooked. These faults, such as a single slack or riding wire are in many cases eliminated during the braiding process. Even so it is much preferred to keep defects of this nature to an absolute minimum during the winding process.

When yarn machines are used for braiding wires it is important to keep the traverse length of the carrier spools as short as possible. Even the positioning of the spools on the carriers becomes of some importance if good results are desired.

To avoid erratic effects the carrier spool should be mounted so that the centre of the winding lines up with the lower thread guide on the carrier tension post.

Carrier droppers fitted with guide pulleys instead of the usual thread guide should be used for this work and these are readily obtainable from the suppliers of the carriers. The main hazard with multi-end wire braiding is the odd broken end. If all the ends break then the carrier dropper will stop the braider almost immediately but if, assuming that four ends per carrier are in use and only one end breaks the dropper will continue to function normally until there is sufficient foul wire on the carrier to either break the remaining three ends or tangle with one of the other carriers and break all four ends. In either case there will be an untidy place in the braid and a following gap made by the missing end. One big advantage with maypole machines is that snarls or gaps in the braid can be eliminated simply by turning the braider back by hand making sure that the slack wires are taken up on all the spools as the machine is reversed. By this method the braider can be slowly reversed until the unsightly place in the braid disappears, when the broken wires from the carrier can be inserted and the machine re-started in the normal manner. One of the problems, frequently encountered when wire is braided on a yarn machine is scraping or scruffing. This trouble is difficult to deal

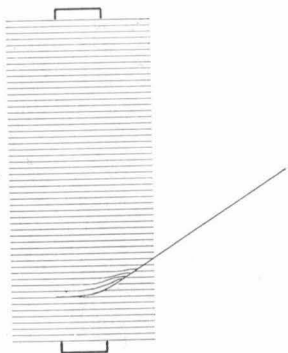


Fig. 50. Scruffing on supply spools

with and in most cases unavoidable. From diagram Fig. 50 it can be seen that as the wire is payed out there is a tendency to scrape and wrinkle several turns of wire on the outer layer. This crinkling effect is at maximum at each end of the traverse due to the angle that the wire takes to pass through the lower thread guide. Tensioning on wire spools is usually heavy and of course this tends to aggravate the situation. Wave-winding would keep the scraping effect to a minimum but to wind wire in this way would create difficulties with uniform tensioning and will considerably reduce the spool capacity.

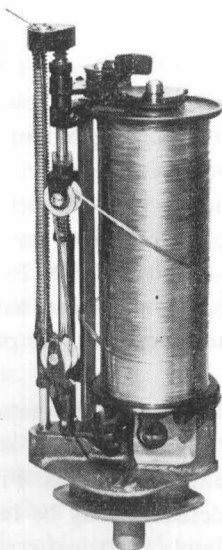


Fig. 51. Heavy wire carrier
(Mossberg Pressed Steel Corp., U.S.A.)

A departure from the conventional is seen in (Fig. 51) the latest heavy duty wire carrier produced by the Mossberg Pressed Steel Corp. of U.S.A. The normal high standards of workmanship and efficiency have been

maintained and the new model is designed to accommodate vertically mounted spools with a wire capacity of 8.37 lbs. As with all braiding machine carriers, good spool winding is necessary for really satisfactory working. A carrier of English design is featured in Fig. 52 and this is

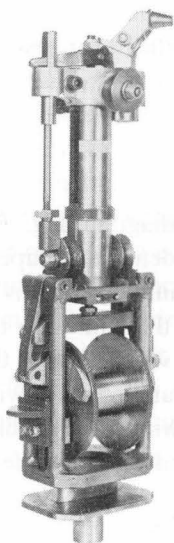


Fig. 52. Heavy wire carrier
(B. & F. Carter, Bolton, England)

the "Max" high capacity unit manufactured by B. & F. Carter of Bolton. Rigidly constructed, the spools are mounted horizontally and low down. There are definite advantages with this type of mounting but of course horizontal spools impose definite limits on the wire capacity.

The carrier can be obtained with either a friction or a ratchet supply release whichever is preferred. A massive vertical wire braider for tubular covering up to 5" diameter is shown in Fig. 53. Built by B. & F. Carter and equipped with 48 special "Max" carriers this machine has been designed to produce a 1 : 1 braid and the sturdy proportions of these heavy duty wire braiders are well illustrated.

The production of high class wire braid is seldom a simple matter, but unfortunately there is a trend in some sections of industry that suggests that a good modern machine is all that is required for results. First the function of the braided sheath has to be considered- it may be required for re-inforcing, or flexible protection or just simple electrical screening.

The purpose of the sheath will enable a decision to be made as to the nature of the wire to be used as usually there are such things as breaking strains, coverage and flexibility to consider.

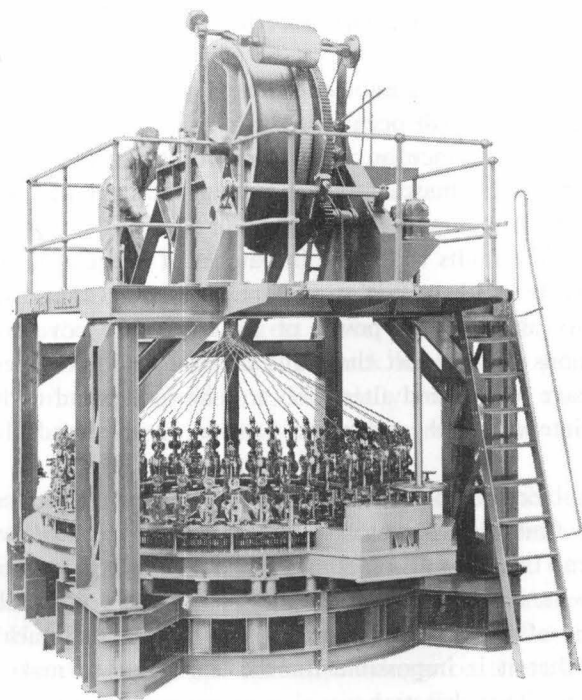


Fig. 53. Heavy duty wire braider (*B. & F. Carter, Bolton, England*)

Annealed or hard drawn copper, soft steel, stainless steel, high tensile spring steel, tinned or nickel plated wires any of these may be required for a specific purpose.

If a change of wire is contemplated some adjustments will have to be made both to the spool winding gear and the braider carriers if good results are desired.

For example if a braiding machine has been producing a copper wire sheath it would unreasonable to change over to a steel wire cover of similar proportions and expect good results without adjustment to carrier tensions.

A uniform rate of feed is desirable with all forms of braiding and although the take-up gear on any braiding machine is positively driven, difficulties are sometimes experienced with reception arrangements for the finished product.

With cable and wire covering or certain types of hose manufacture the braided product is normally wrapped several times round the take-up sheave on the braider before passing on to the reception drum or reel.

This reception reel is usually rotated with the aid of some form of

slipping drive in order to compensate for the slowly increasing diameter of the wrapped product.

If the reception reel is unbalanced or a reel with damaged flanges is used erratic rotation will occur.

In the second instance an intermittent braking effect will sometimes be produced by the buckled flange rubbing at intervals on the side of the reel stand.

Either of these faults will result in patches of irregular braid and in the case of wire braid the situation will be aggravated, because wire lacks the flexibility and gripping power of a similar yarn covering.

In situations of this sort the turns of wire braid wrapped round the take-up sheave would tend alternately to loosen, slip and tighten up again at regular intervals with spasmodic patches of open and close braid as a result.

On the subject of horngears it sometimes happens that foreign matter accidentally finds its way into the gear train. A piece of broken spring or a short end of wire will sometimes cause misleading symptoms. In most cases the wire or metal drops through the tracking and adheres to the teeth on one of the horngears. Attempting to turn the machine by hand will reveal that it is impossible for the horngears to make a complete revolution in either direction.

This is a sure indication that there is an obstruction in the gear train. The remedy for this, is to remove the guard from the deck, and turn the machine by hand in either direction until the obstruction can be felt.

Do not use force, when the locking point is reached but slowly reverse the machine for approximately a quarter of a revolution of the horngears. Careful examination of each horngear in turn, both from the inside and the exterior of the deck will usually reveal the obstacle which can be removed.

In extreme cases where the foreign matter has become embedded it may be necessary to use a hammer and a sharp pointed punch or chisel to effect the removal.

The affected gear teeth should be carefully examined for cracks or partially broken teeth before attempting to resume work with the machine.

3.2. Machine Drives

Braiding machine drives are more or less conventional and four types are in general use.

1. The Dog Clutch
2. Fast and Loose Pulley
3. Direct Motor Drive (Gears)
4. V Rope drive.

With the smaller types of braider, the dog clutch is the most popular method of drive, being positive in action and of simple construction. Typical clutches are usually plain good quality castings requiring an absolute minimum of machining and they can either be spring loaded or actuated by a combination of gravity and vibration.

The fast and loose pulley system calls for little comment except that it is somewhat sluggish in action and is generally found in use on the heavier types of braider.

The development of the geared fractional horse power electric motor is responsible for the use of the direct drive, but with this arrangement, starting the machine imposes a severe shock load on the gear train.

The ideal form of transmission, especially for heavy duty machines seems to be the short centre multi- V rope drive with some form of safety device such as an overload clutch.

The nature of the braid depends to some extent upon the rate at which the product is drawn from the machine and almost without exception this production speed is varied by means of change gears. A variety of feed gear systems are available depending upon braid requirements and for most types of soft flat braiding a two or three roll feed system is used, similar in some respects to the domestic wringer on a small scale. With cable covering or wire armouring it is usual to find a take-up sheave or haul-off capstan in place of the roll-system.

Elastic braid introduces further complications with regard to feed systems. Flat elastic is produced by passing strands of rubber under tension through the hollow horngear studs of the braider. It is difficult to maintain a uniform tension on rubber strands as they are being braided.

Theoretically, the relation between the take-up speed and that of the feed spools should be kept constant, a condition that is not easy to achieve with gradually unloading spools of rubber. A useful individual rubber tension guide is manufactured by Mossberg Pressed Steel Corp. U.S.A. and can be obtained to fit the majority of standard braiding machines.

3.3. Some carrier and tracking arrangements for special braids

The standard stitch used for the bulk of tubular braiding is 2 : 2 (two over and under two) and the normal carrier positions for a twenty four carrier tubular machine are shown diagrammatically in Fig. 54. If the tracking diagram is studied it will be seen that one hornsplot is loaded and one hornsplot is vacant in either direction.

It sometimes happens that a diamond or basket weave is required for a tubular braid specification. This weave is known as a 1 : 1 stitch or

(one over and under one). A diamond braid can be produced on a standard tubular maypole braider simply by re-arranging or removing some of the carriers.

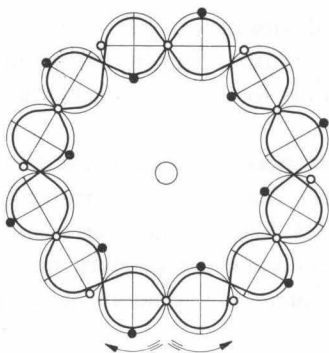


Fig. 54. Standard braid carrier setting

Fig. 55 shows an arrangement for producing a Diamond or Basket weave. A wide stitch is produced with this arrangement and it will be observed that the carriers are grouped in pairs, two hornslocs loaded and two vacant in either direction. The advantage of this set-up is that all the carriers are kept in use.

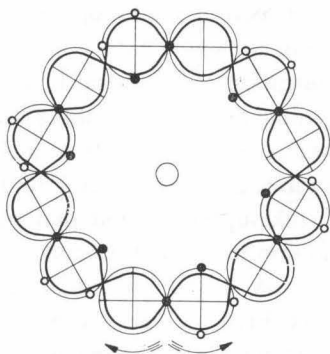


Fig. 55. Diamond braid carrier setting

The other method of producing this braid is to remove six of the carriers from each section of tracking and with our twenty four carrier machine this will mean one hornsloc loaded and three vacant in either direction.

The six carriers travelling in each direction must be arranged or positioned symetrically in the interest of uniform braid. The second method has the disadvantage that the number of ends of yarn per carrier will have to be increased and some adjustment will have to be made to the rate of feed to ensure good coverage.

Flat braider tracking and carrier positioning form the subject of the next series.

First a 25 carrier, 6 line plain flat braider with standard four slot horn gears and five slot terminal gears. Carriers are arranged one horn slot loaded and one vacant (Fig. 56) and when in this order the machine will produce a standard or 2 : 2 braid.

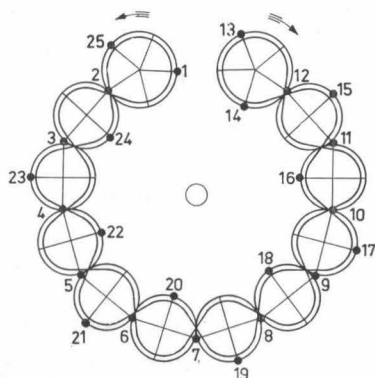


Fig. 56. 25 carrier-6 line flat braid set-up

Normally the majority of flat braiders are worked with an odd number of carriers, but occasionally it becomes necessary, due to the nature of the braid or colour combination to use an even number of carriers. As an example consider the 25 carrier 6 line braider mentioned previously.

The carriers in this machine cannot be grouped evenly so the horn gears are re-arranged in order that the machine will function with 24 carriers.

The re-arrangement is shown in Fig. 57 and this set-up will consist of

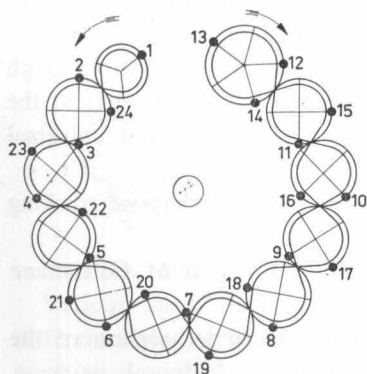


Fig. 57. 24 carrier-6 line -3 horn flat braid set-up

four slot horn gears with one 3 slot terminal gear and one 5 slot terminal gear. Except that there are 24 carriers the positioning is the same—one slot loaded and one vacant thus producing a 2 : 2 braid.

The reason for the odd number of hornslots in the terminal gears is to keep the carrier positions correctly related when they are reversed into the other half of the tracking.

Next a 26 carrier 6 line diamond flat braider (Fig. 58).

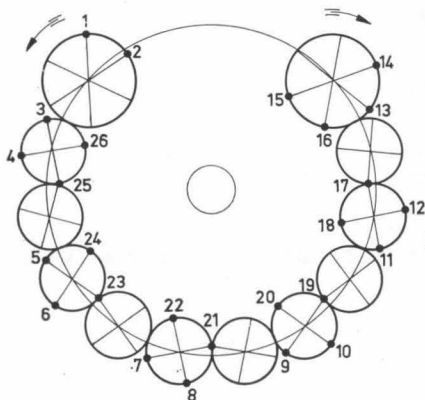


Fig. 58. 26 carrier-6 line flat diamond braid set-up

Standard 4 slot horgears are used with 6 slot terminal gears. Carrier sequence is two slots loaded and two slots vacant and the resulting braided product is 1 : 1 or a diamond weave.

From the previous examples it would appear that three different braiding machines would be required to cope with the varying styles, but this is not the case because provision can be made for changing the terminal gears in the machine to suit the style of braid required. If so desired the majority of braiding machines can be built with provision for changing the terminal gears in a very simple manner.

Textile Machine Works, U.S.A. use a standard 4 slot horgear with compound gears. When this special horgear is in position, next to the terminal gear it is a simple matter to use a 3, 5, or 6 slot universal terminal gear as and when required.

An interesting example of a braider with a special purpose tracking system is to be seen in (Fig. 59).

This is a 19-25 carrier cord edge braider built by W. & M. Ostermann of Wuppertal-Barmen, Germany.

A two head double flat braider, the nineteen carrier section of the tracking is that of a conventional flat machine.

One terminal end of the 25 carrier track is linked by means of an auxiliary horgear to the two terminal gears of the 19 carrier section. Arranged in this way the 19 carrier section functions as an ordinary

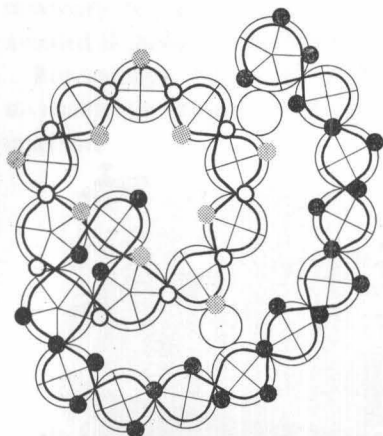


Fig. 59. 19-25 carrier cord edge braider
(*W. M. Ostermann, Germany*)

tubular braider and a tube or cord is formed on one edge of the flat braided strip produced by the 25 carrier-section.

Another special purpose machine is the stripe braider and the tracking of this type of machine is set out so that the braided product will consist of two or more flat braids joined at the edges to produce a vertical stripe effect.

The tracking and carrier arrangement of a 12×12 carrier simple stripe braiding machine is shown in Fig. 60. This machine will produce

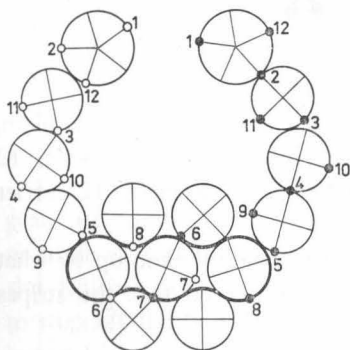


Fig. 60. Simple 12×12 stripe braider
(*Textile Machine Works, U.S.A.*)

two stripes, each stripe consisting of a plain 3 line braid.

Various track formations are possible with this type braider and different styles of braid can be included as can be seen from the next machine described.

Fig. 61 shows a compound machines: —

$12 \times 12 \times 13 \times 9 \times 12 \times 12 \times 13 \times 9 \times 12 \times 12 \times 12$ giving a formation of 11 stripes with a total of 128 carriers.

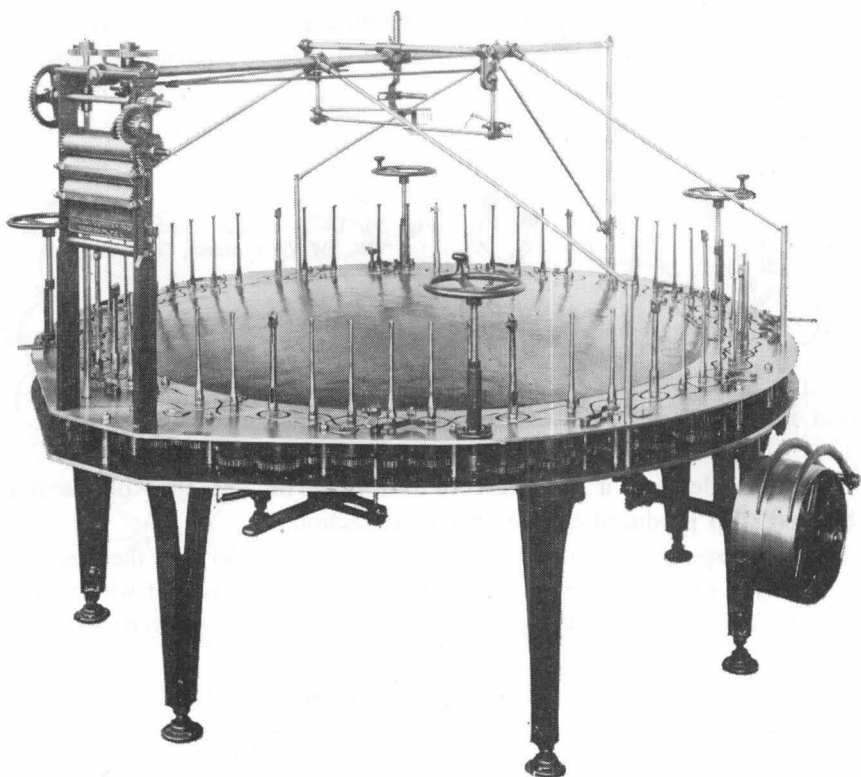


Fig. 61. Compound fancy stripe braider (*Textile Machine Works, U.S.A.*)

Stripe formation with this elaborate braider consist of 3 line plain, 12 carrier president, 3 line plain, 9 carrier soutache, 3 line plain, 12 carrier president, 3 line plain, 9 carrier soutache, 3 line plain, 12 carrier president and 3 line plain.

With this combination of tracks which are normally linked up by what is known as horseshoe connections it will be observed that the stripes need not consist of plain flat braid.

A special carrier and tracking arrangement is usually necessary for the production of "Hercules" braid.

Seldom encountered nowadays this style of stitch is known as 3 : 3 (three over and under three) Fig. 62.

For a 37 carrier 6 line "Hercules" braider 6 slot horn gears and 7 slot terminal gears are used.

Occasionally there is a call for flat braid when the only machines available are for tubular work. In circumstances like this it would seem

necessary to obtain some flat braiding machines. This expense can be avoided if standard machines are in use.

For example New England Butt Co. U.S.A. can supply special parts to enable the manufacturer to produce flat or tubular with the same machine.

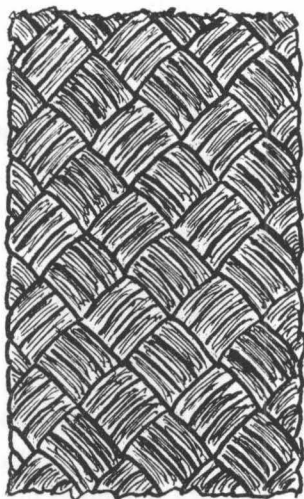


Fig. 62. Hercules or 3 : 3 stitch

When a tubular braider is converted for flat work it is necessary to reduce the number of carriers by three. Should a flat braider be required for tubular work then the carrier total is reduced by one.

Special gears are needed for the purpose of changing from one style of braid to the other and for New England Butt braiders these are known as Keleher gears.

When changing from tubular to flat braid two sets of these Keleher gears are required and to make the change it is necessary to remove three or more of the existing horn gears in the front of the machine. The five slot Keleher gears are then inserted in the position where it is desired to stop off the braider. Each gear is fitted with an eccentric bush to be inserted in the bore of the gear before it is placed in the machine.

The eccentric bush allows the five slot horn gear which is larger in diameter than the standard horn gears to be correctly adjusted for gear relationship when in position.

Suitably shaped quoit plates are carefully bolted in position over the newly inserted five slot horn gears and stop off quoits are fitted into the tracking spaces left vacant by the removal of the existing four slot horn gears.

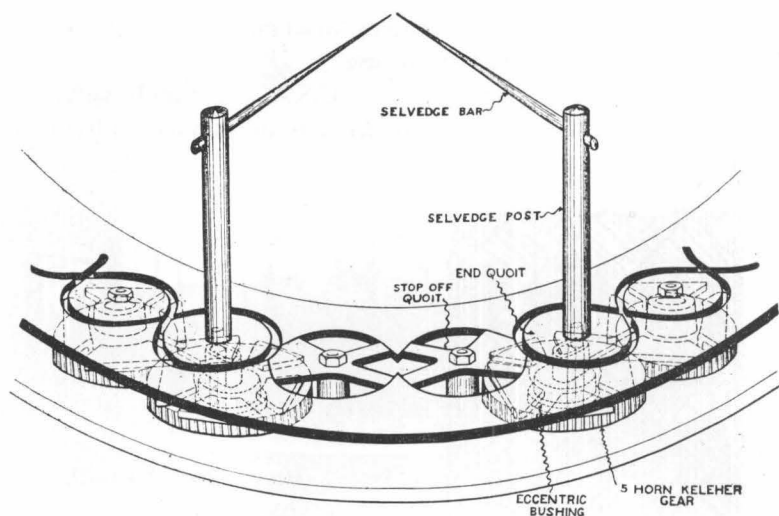


Fig. 63. Keleher gears (*N. E. Butt Co., U.S.A.*)

Fig. 63 shows a deck with four existing horn gears removed.

Two Keleher gears and two stopping-off quoits are fitted in place.

Whereas a good percentage of braiding of all descriptions is produced on vertical machines, it is sometimes advantageous, as in hose making to use horizontal braiders.

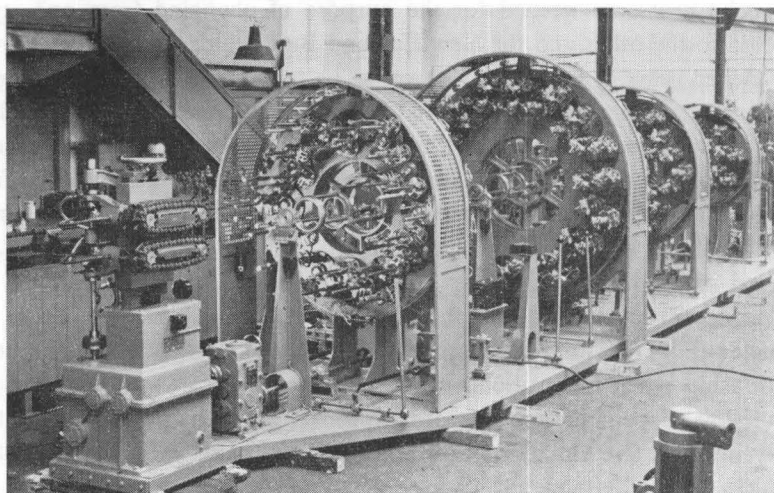


Fig. 64. Four stage horizontal braider (*W. & M. Ostermann, Germany*)

With test pressures for small bore hoses sometimes exceeding 30,000 lbs per square inch, extremely exacting conditions must prevail during manufacture.

A riding wire, or any stitching irregularities can have serious consequences.

Fig. 64 shows a typical four stage horizontal braider with a caterpillar haul-off. This machine was built by W. & M. Ostermann, Germany, and is constructed on the unit system. Speeds can be varied on all four heads and a central pressure fed lubrication system is used for each of the decks.

As stated earlier, high pressure hoses are built up on long mandrels and with normal braiding technique a lot of space is required to allow the passage of the mandrel through the braiding machine. A well known English firm has introduced a new method for this process whereby the braiding machine travels along the mandrel instead of the mandrel being pulled through the braider, thus effecting a considerable economy in space required.

3.4. Terminology used in connection with maypole Braiders

1. *Carrier or spindle*

The means by which a spool or supply of yarn or wire is conveyed during the braiding process. The majority of maypole type braiding machines are described by quoting the horngear diameter and the total number of carriers or spindles used.

2. *Spool, Bobbin or Cop*

Wood, Metal, or Plastic reels with or without ratchet teeth on one flange. The required amount of yarn or wire is wound on these and they are then placed on the carriers.

In many instances yarn is wound to definite dimensions on to cardboard tubes, and these are usually known as cops.

3. *Copholder*

When cops are used, it is necessary to use a copholder and these generally take the form of a ribbed spring steel tube with a flange and ratchet teeth at one end.

4. *Supply Pawl or Latch*

A pivotted shaped lever usually situated at the base of the spool pillar on the carrier, the function of which is to release the spool so that yarn or wire is paid out as required. Many of the older braiding machines

were equipped with top latch carriers and with these the supply pawl or latch was situated at the top of the spool pillar.

5. *Tension Post or Stand*

A vertical tube or rod that acts as a guide for the dropper and with certain types of carrier is used to accommodate the tension spring. The yarn or wire outlet guide is attached to the top of the carrier tension post. Many old time drop weight carriers consisted of a base and tension post cast in one.

6. *Dropper*

A shaped weight or steel stamping that is free to fluctuate according to the supply requirements. The dropper performs the double function of controlling the tension and stopping the braider when necessary. In the event of a yarn breaking, the weight falls to the bottom of the tension post and in this position should strike the knock out lever, which in turn operates the shipper mechanism and thereby brings the braider to a standstill.

7. *Carrier Thread Eye*

Normally there are two fixed thread eyes per carrier. There is also a thread guide on the dropper but this usually takes the form of a hook or small guide pulley.

For general yarn work thread eyes are made of hard polished steel but when delicate filaments are being braided it is sometimes an advantage to use porcelain eyes.

As the name implies thread eyes are used to guide the yarn from the carrier spool to the braiding centre.

8. *Supply Pillar*

Usually a plain steel rod one end of which is a force fit in the carrier base casting. The spool or copholder is placed on this rod ready for threading up.

9. *Carrier Base*

Can be fabricated steel or a high grade casting. The upper portion carries the supply mechanism and spool and the under portion is shaped to suit the contour of the tracking and the horn gear slots.

10. *Horn gear*

A single unit of the gear train used for carrier propulsion.

11. *Horngear Stud*

Sometimes hollow, sometimes solid this stud is a bearing or pillar on which is mounted the rotating horngear. On some machines it is utilized as a spacer for quoit and base plate.

12. *Quoit*

The term used for the small shaped plate forming part of the tracking in a slide plate braider. It is generally clamped to the horngear stud and is situated immediately above each horngear.

13. *Star Plate*

The inner or centre plate forming part of the tracking system.

14. *Outer Plate*

The outer plate forms a major portion of the tracking and is sometimes used as a platform for the feed gears and take-up sheave.

15. *Base plate*

The lower or foundation plate of the deck assembly. Normally the driving mechanism, horngear studs, spacers and horngears are mounted on this plate which is sometimes designed to be used as a splash feed oil bath.

16. *Deck*

Complete assembly of Base plate, horngears and tracking.

17. *Stop motion or Cut-out*

A shaped lever or levers held in position by some form of catch. Situated on the track plate so that in the event of a broken yarn or a spool becoming empty, the carrier dropper disengages the lever. This in turn releases the driving gear and stops the machine.

18. *Braid Guide or Former*

This varies considerably in design according to braiding requirements and it performs the important task of holding the braid steady at the point where the yarns are interweaving. For tubular braid a plain, polished bell mouthed ring usually suffices. When in use it is important to correctly position the guide and this procedure calls for a certain amount of experiment.

For flat braids a former with a U shaped opening is used, and a wide variety of openings are generally needed to cope with different styles of braid.

19. *Selvedge Bars*

These are long polished steel needles for use on flat braiders fitted with 25 or more carriers.

These are carried on posts, normally mounted on the centre of the terminal horn gear studs.

The points of the selvedge bars are set in position near the throat of the braid former and a certain amount of experimenting with positioning is required for good results. Yarns should drop easily from the points of selvedge bars to introduce a gentle plucking action.

This action is of assistance in forming a firm clean edge to the braided ribbon.

20. *Beater*

When using machines with many carriers it is sometimes necessary to use a form of beater system to ensure a firm clean braid design. As the length of the tracking increases, the distance from the top thread eyes in the carriers to the braiding centre also increases. The greater this distance the more there is chance of slight slackness in the yarns.

Beaters are used to eliminate this tendency and commonly take the form of combs which beat on to the yarns near the braiding centre. On the larger machines this beating action takes place all round the braiding centre and the device used has the appearance of a crown hence the term crown beater.

21. *Warp Guides*

A ribbed effect can be produced on either flat or tubular braids by using warp or vertical threads.

To produce this effect it is necessary to have a braider fitted with hollow horn gear studs and warp guides.

These warp guides can be fitted to any of the quoit studs. In the case of many elastic braiders warp guides are used on all the studs and rubber threads are passed through the centre of each horn gear.

22. *Extractor or Button Plate*

A small readily detachable plate, blended with and forming a part of the tracking. This plate has to be removed when taking out or inserting any or all of the carriers.

23. *Take-up Gear*

The method used for drawing the finished braid from the braiding centre. This gear is arranged in a variety of ways depending upon the nature of the braiding.

The working speed of this gear is constant, any variation is made by means of change gears. For wire or cable covering a sheave is used – a gear driven flat faced or coned pulley. Wire or cable in the process of being covered is wrapped several times round the pulley, and from there it passes on to a reception reel.

For flat braid a feed roll system is used the action of which is very similar to that of the homely domestic wringer.

The finished product is pulled from the braid former by the feed or take-up rolls and passes to another set of rolls situated at the back or side of the machine, well clear of the carriers.

These auxiliary rolls are referred to as take-off gears and are used for discharging the finished braid into a suitably situated container.

24. *Change Gears*

Gears used to alter the rate of feed according to the braid required.

25. *Terminal Gears*

Horn gears at the tracking extremities of plain flat braiders. They normally have an odd number of horn slots to maintain the relationship of carriers as they are transferred from one track to the other running in the opposite direction.

26. *Keleher Gears*

Special horn gears used for converting tubular braiders to do flat braiding.

27. *Reception and Let-off Reels*

Mainly used for wire or cable covering. The product is transferred from one to the other of these reels which can vary in size from 6" to 15 feet in flange diameter.

28. *Driving Gears*

Normally this refers to the complete assembly for transmitting motion to the horn gear train.

29. *Cross Shaft Pulley*

A multi-grooved pulley fitted to the change gear shaft and which is used for driving reception reels. An endless cord or rope couples the cross shaft pulley and a similar grooved pulley on the flange of the reception reel. Tensioning is provided for in the form of a suitably located jockey pulley and by this means a simple slipping drive is provided.

This type of drive is normally satisfactory even on heavy duty braiders.

**MECHANICAL AND OPERATIONAL FEATURES
OF THE
“WARDWELLIAN” RAPID BRAIDER**

Examination of a modern “Wardwell” braider reveals some very interesting and novel mechanical features and the general design of the braider is such, that given ordinary care and attention the machine will provide many years of useful service. Basically the same as earlier models the present day “Wardwell” has been simplified and improved upon and can be used on a wide range of materials such as rayon, glass, nylon orlon and almost any of the new synthetic fibres. Simply by obtaining extra attachments, the machine can be used for metallic braid.

For this work speed will have to be reduced by roughly 40 % to 50 % and subject to a little care being taken in setting up, a first class braid can be produced with wires not exceeding .012” dia.

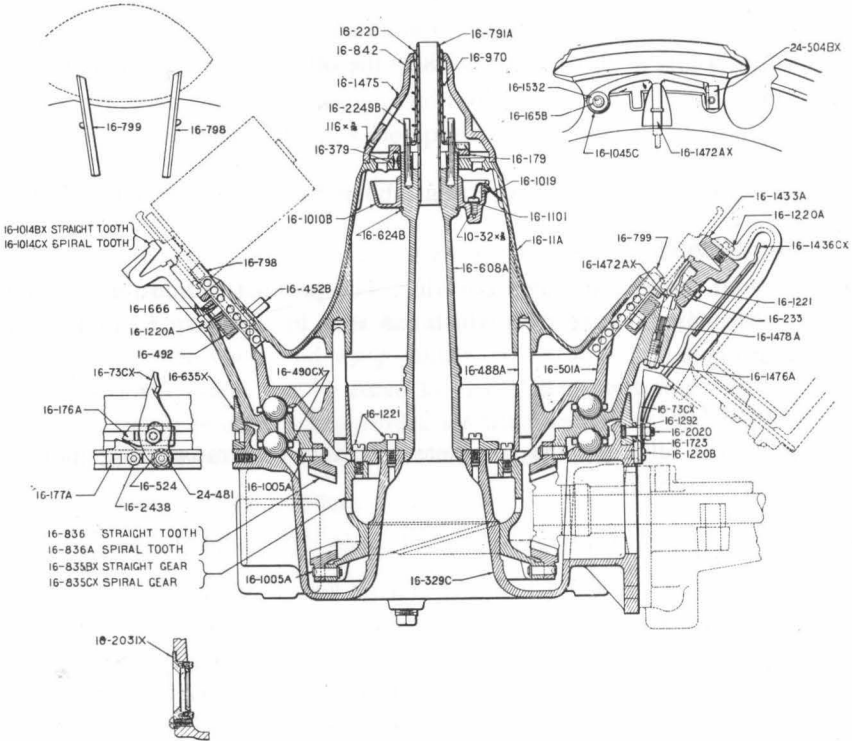


Fig. 65. Standard 16 carrier “Wardwellian” (Wardwell Braiding Machine Co., U.S.A.)

A sectional view of a 16 carrier braiding head is shown in Fig. 65 and attention is drawn to the coding system.

Advantage will be taken of this coding which will be used for identification purposes when describing some of the mechanical features associated with the braider.

4.1. Base

Commencing with the base 16-329 C. it is apparent that this casting combines the functions of containing the driving gears, supporting the track and driver plates and as well as being a splash feed oil sump it provides a mounting for the driveshaft gear box and driving clutch.

Oil level is clearly indicated by means of a sight glass window.

4.2. Track Plate

Both the track plate 16-1014 CX and the driver plate 16-501 A are mounted on ball bearings and an unusual feature of the sixteen carrier machine is that the ball tracks are machined in the track plate, driver plate and base castings. Although this is unorthodox, there are many braiders that have been in constant use for 25 to 30 years and with systematic servicing no ill effects are apparent with ball tracks manufactured in this manner.

The track plate resembles a large cone shaped basin, with gaps in the periphery at regular intervals according to the number of carriers.

A "V" shaped groove is machined in the periphery of the track plate and on the inner wall of the "V" track a narrow shallow groove is cut. This shallow groove acts as a retainer for the upper carriers which are an easy slide fit in the "V" track.

4.3. Upper Carriers

The upper carriers sliding in the "V" track are pushed or pulled in the opposite direction to the track plate by means of cam operated hardened steel carrier drivers fitted two per carrier in slots in the driver plate 16-501 A.

Cotton, yarns or wire from the lower carriers has to pass alternately over and under each pair of upper carriers for the formation of a standard braid and this ingenious transfer system is shown in (Fig. 42 Page 26).

Pressed steel deflectors 16-1436 CX. and four in number are attached to the base of the machine. The boat shaped upper carrier, the deflectors, and a shaped deflector on each lower carrier, this and the movement of the machine combine to form a guide for the lower carrier yarn or wire supply and thus form the braid.

The driver plate and track plate rotate in opposite directions and spiral bevel gears are used to promote this action. The use of this type of gear is conducive to smooth running and accurate timing.

Yarn supply release for both upper and lower carriers is by means of a spring loaded pawl and ratchet and springs can be readily changed to suit different materials. The ratchets on both upper and lower carriers are excellent examples of modern pressed steel work.

The upper carriers take the form of boat shaped castings and should always be handled with care as they form part of the yarn or wire deflection system.

Each carrier is numbered and if for any reason carriers are taken out it is important when replacing them to make sure that the number on the nose of the carrier keel corresponds with the number stamped on the scallop in the driving plate. Should at any time, either because of wear or accident, a new upper carrier be required it should be numbered the same as the one taken out and then the makers' instructions for fitting new carriers should be strictly followed.

Burrs, sharp edges or slight rust cannot be tolerated on the polished deflection surfaces of the upper carrier.

The upper carrier stop 16-899 will function in the event of a foul spool winding, a broken yarn, or a spool running empty. Yarns or wire should always be securely fastened to the cop tube or spool at the commencement of winding. Failure to observe this simple precaution increases the hazard of a loose end fouling the braid before the machine is brought to a standstill.

A high percentage of irritating minor troubles with high speed braiders arise through inability to correctly diagnose a fault. Whatever type or make of braider in use, operators should be given a certain amount of latitude, to enable them to become thoroughly familiar with any peculiarities associated with a particular make of machine.

Puzzling and infuriating faults can develop occasionally which are not even due to mechanical defects.

To quote an example, trouble was encountered with a battery of "Wardwells" used by a well-known manufacturer.

The complaint was that here and there a machine would run normally, sometimes for several hours and then for no apparent reason, the yarns would foul and break.

Careful examination of one of the offending machines revealed that it was in good working condition.

At the time the braiders were used without the polished steel protective

top caps provided for use with the upper carrier spools. A set of these caps were clipped in place and the trouble ceased.

This led to close examination of the yarn spools which had been obtained ready wound from an outside supplier.

In winding these spools, knots had been tied where yarn ends had been joined and quite a number of spools were found with a knot protruding on the upper periphery.

This gave a clue to the trouble – the yarn supply from the lower carriers in passing over and under the upper carriers was occasionally trapped and delayed on one of these knots protruding from the top of the upper carrier spools.

This would only occur at odd times and depended upon the position of the knot on the rotating upper carrier spool in relation to the passing of the lower supply yarns.

Tests were made afterwards with spools that were knot free and the braider functioned normally even when minus the protective steel caps.

In connection with upper carrier stops it sometimes occurs that the braider fails to stop with a broken yarn from an upper supply spool. This is an obscure fault usually associated with machines that have been in constant use for a number of years. The upper carriers should be removed and the lower end of the carrier stops examined in turn. If any of these stops are worn they should be replaced. Before replacing the carriers examine the working faces of the upper supply stopping levers 16–1045 C. In each case the stopping lever should be pushed down as far as it will go to make sure that it is working freely. If any levers or plungers are showing signs of wear, they should be removed and new ones fitted.

What happens is that continual use rounds the lower end of the upper carrier stop and in extreme cases the working face of the stopping lever also becomes worn.

In this condition the stop instead of pushing the stopping lever down, rides over the top of the lever and the braider continues to run with one or more of the supply spools out of action.

Upper carrier thread guides 16–1048 B are prone to cause trouble if incorrectly set. This guide has a hooked top and if for example a five end yarn is being used and one of the upper carrier thread guides is slightly out of position yarns from the lower carriers will tend to split on the hooked top end of the thread guide. Thus instead of all five ends laying together, three will remain side by side and a slight delay will occur with the remaining two.

What happens then is that the three ends will pass correctly under or over the upper carrier and the two ends that are lagging behind will catch the nose of the oncoming upper carrier on the wrong side.

When this happens the yarn from the outer carrier will either pass incorrectly or break, the result being faulty braid in any case.

4.4. **Timing**

This is an extremely important feature of all high speed braiders. Any suggestion that timing should be varied should be looked upon with disfavour and before any machine is dismantled careful note should be made of any timing marks.

The "Wardwell" is clearly marked on the bottom crown wheel, driver plate, track plate and brake band.

If for any reason a machine has to be dismantled it is essential that all these timing marks line up on re-assembly.

Even so, when securing the bottom crown wheel to the driver plate there is always the hazard that the gear teeth will ride and pull up one tooth out of step.

It is quite possible for this to happen inadvertantly especially if the assembly is made hurriedly.

Unfortunately, once the machine is assembled there is little to indicate any fault until the braider has been started whereupon it will probably run for a minute or two before all the yarns break.

Another effect that can occur through mis-timing is that the upper carrier stop plungers will be out of step and in this condition, a broken yarn, or an empty spool on any of the upper carriers, will not stop the braider.

Upper carrier drivers 16-798 & 16-799 have the working ends slightly rounded when new but after the braider has been in service for a considerable time these rounded edges wear away and become razor sharp.

If oiling is not regularly attended to when the carrier drivers are in this condition there is always a possibility that the driving slots in one of the carriers will be cut away by the drivers and the carrier ruined. When upper carriers are found with sharp edges in the slots, they should be rounded off with a smooth swiss file, and the carrier drivers can be given a new lease of life by stoning the sharp edges down with a fine carborundum stone, care must be taken to wipe away any of the abrasive when the driver bar is finished. It should be noted that carrier drivers are right and left handed and when driver bars are being inserted they must be replaced in correct order.

If at any time all the carrier driver bars are taken out it is a good plan to remove each pair in numerical order and thread them together on a length of wire or braid. In this way they can be put into service with the carrier they were taken from, and any mis-fitting due to wear will be avoided.

4.5. Carrier Jamming

This is a frequent source of annoyance and in most instances faulty spool winding is the source of trouble.

It is caused by the yarn or cotton from the lower carriers breaking and becoming wedged between the sides of the upper carrier keel and the outer V track.

The normal procedure for a jammed carrier is to locate the jam by gently rocking each upper carrier in turn until the tight one is found.

The normal method of freeing a jam is to first tie up in the running position, the tension levers of any carriers with broken yarns. Remove the driving belt, let the clutch in and then take hold of the tops of the pressed steel portion of two opposite lower carriers.

The outer track should then be worked backwards and forwards until the track begins to move, when usually the offending yarn or cotton can be pulled out and the carrier freed. On no account must the outer track be worked too far in the opposite direction to which the braider normally runs and extreme force must be avoided.

If the carrier which is jammed cannot be released in this way two alternatives can be tried.

1. A wheel spanner can be used on the driving clutch to turn the machine back.
2. The tight carrier can be gently tapped backwards with the aid of a short length of copper or brass rod, one end of which should be placed against the cheese head screw that is used to secure the upper tension stand to the carrier. Whatever method is used it is vital to avoid extreme force.

In all cases it will be found that once the jammed carrier starts to move it is a simple matter to pull the yarn from between the carrier keel and the track.

4.6. Tensioning

Regarding the carrier tensioning of yarn or wire this is best determined by experience and circumstances.

Upper carriers seldom give cause for anxiety and it is usually a simple matter to obtain a smooth pay out because deflection does not have to be considered. Attention should be given to the upper supply ratchets to make sure that they rotate freely on the spindles. A very slightly bent or dry ratchet spindle can cause a lot of trouble.

Care should be concentrated on the correct tensioning of the lower carriers because yarns or wire from these has to pass over deflector guides and also over and under the upper carriers. With the lower carrier threaded up take hold of the yarn and pull it rapidly and evenly towards the braiding centre or die. The yarn should pull smoothly from the carrier spool without slackness or bouncing on the part of the tension lever.

Four grades of carrier tension spring are available and whatever springs are fitted a simple form of carrier adjustment is provided so that the operator can set tensions to suit any materials being used to form braid.

4.7. Stopping Levers (Brake)

The stopping mechanism of the "Wardwell" braider is ingenious and somewhat difficult to describe without having a machine for demonstration.

Situated underneath the outer track and resting on a machined face on the base casting is a cast iron ring.

The brake ring 16-635 X functions in a similar manner to an ordinary metal to metal cone clutch.

Stopping levers 16-73 CX are attached to the brake ring which in turn is linked up with a trigger mechanism for releasing the clutch.

Should a yarn from one the upper carriers foul or break, the carrier stop is pulled down or falls and in either case the lower end of the stop protrudes through a slot in the carrier. The protruding end pushes one of the stopping levers down and in turn this depresses a spring loaded plunger, which strikes one of the brake levers. The motion of the outer track forces the brake lever down and operates the trigger mechanism for releasing the clutch. At the same time the movement of the brake lever forces the brake ring firmly against the outer track base and quickly brings the machine to a stop. Fig. 66 shows how the upper carrier stopping system works.

The lower carrier stop functions in a similar manner except that the stopping wire 16-162 B operates directly upon the brake lever as shown in Fig. 67.

Lower carrier stop wires should be examined periodically, making sure that these stop wires move with perfect freedom. A foul or slightly bent stop wire can be a nuisance that is not readily discerned.

Whenever operators or service mechanics are not fully conversant with peculiarities usually associated with a particular type of machine there is a tendency for minor difficulties to increase. High speed braiders are

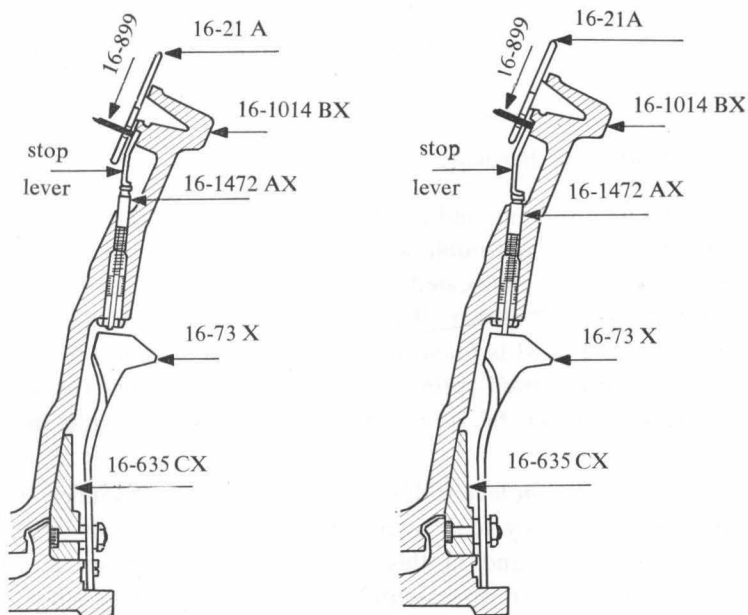


Fig. 66. Upper carrier stopping "Wardwellian"
(Wardwell Braiding Machine Co., U.S.A.)

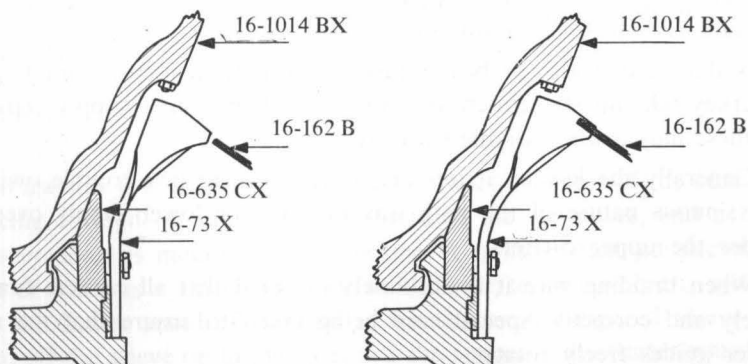


Fig. 67. Lower carrier stopping "Wardwellian"
(Wardwell Braiding Machine Co., U.S.A.)

no exception and when a fault or mishap occurs more than once it is very necessary to thoroughly investigate in order to avoid inferior work.

Sometimes a chance remark from an operator will provide a clue, but in most situations of this sort the service mechanic has to rely upon his own knowledge of the braider in order to cope with faults.

Some of the more common faults and appropriate remedies are listed below.

1. Intermittent Yarn Breakage

Keep the machine running and carefully observe which carrier or carriers are affected. Usually the trouble will be confined to one particular carrier and when this has been located some attention should be given to all working parts of the carrier. The supply ratchet should be removed, cleaned, and if the pawl is found to be badly worn it should be replaced. Any stretched or distorted springs should be renewed, and whenever the supply ratchets are put back on the carrier, they should spin freely on the spindles.

Lower carrier tension levers should be removed and examined because after prolonged use they tend to become partly cut through by the eye of the tension spring and in this condition will sometimes affect the smooth pay-out of yarn so essential to normal working. When badly worn a new tension lever should be fitted. Lower thread guides and deflectors should be checked by running a finger along the polished surfaces. Any roughness or burrs should be eradicated by rubbing down with a smooth "Swiss" file and polishing with fine emery cloth. When yarn breaking occurs with more than one carrier it is sometimes advisable to look elsewhere for a solution.

A damaged beater or beater tube, a wrongly positioned braiding die, a jerkey take-up reel clutch, or omission of the upper supply caps, any of these may cause sporadic yarn breaking.

Generally the lower carriers are more prone to give trouble owing to the sinuous nature of the path traversed by the lower supply over and under the upper carriers.

When braiding wire it is absolutely essential that all carriers function freely and correctly, special care being taken to ensure that the many roller guides freely rotate.

Lubrication of the working parts of all carriers should be carried out with discretion, and kept to a minimum rather than a maximum.

2. Stopping or Brake Levers

The maker's instruction for setting and adjusting the shipper and braking mechanism should be strictly adhered to.

3. Beater

A feature of the "Wardwell" is a built in inverted beater and this is mainly in use when the rate of feed is low. The beater assists with the formation of a firm clean braid when the yarns are forming braid on top of the nose cap.

4. Braid Softener

When using fine yarns for covering certain types of cable there is a tendency for these threads to bite deeply into the cable sheath. For various reasons this is undesirable and there are two methods of avoiding this tight braiding.

The simplest remedy for this, is to considerably reduce tensions and running speed, a procedure that is usually unpopular with production people.

The alternative is to use a specially made attachment which fits on the top cover cap and beater. (Fig. 68).

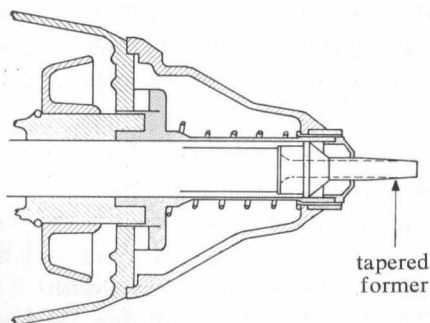


Fig. 68. Braid softener "Wardwellian"
(Wardwell Braiding Machine Co.,
U.S.A.)

To use this it is necessary to know the exact diameter of the core that is being covered. A short sleeve is fitted to the top cover, and a braid softener dome is mounted on the beater. A polished tapered sleeve, the bore of which is a close sliding fit on the core to be covered is screwed into the beater stand. The braid is formed on the tapered sleeve and eased off the sleeve on to the core, and the action of the beater materially assists during this operation.

When using this attachment, normal braiding speed can be maintained

and a sufficient amount of yarn tension can be incorporated to keep the threads in proper time.

If too little tension is used, the threads tend to lag and either stop the braider or catch between the carrier and track plate section.

5. Driving Clutches

Can be relied upon to give trouble free service for years if properly adjusted. A harsh screeching noise on letting the clutch in is a sure indication that the driving faces are not engaging properly and if this warning is ignored a new clutch will be needed in a very short time.

6. Upper Supply Caps

Polished pressed steel caps that clip into the top of the cop tube or bobbin on the upper carriers can be fitted to assist with the smooth transfer of lower supply yarns over and under the upper carriers. In many cases the machine will run quite well without these caps but nevertheless it is beneficial to use them because there is always a tendency for the lower supply yarns to drag and delay on the upper carrier spools.

These protective caps should always be handled with care as a bent, rusty or burred cap can sometimes cause more trouble than no cap at all.

7. Change Gears

All change gears are machine cut and when fitted should not engage too tightly in mesh. The gears required are slipped on to the shaft and a steel collar with one face machined to engage in a slot in the gear boss is

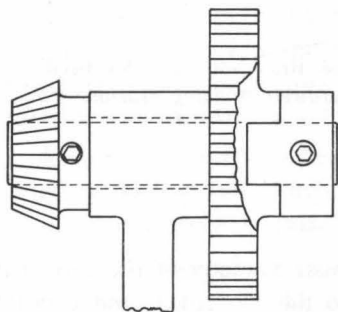


Fig. 69. Change gears "Wardwellian"
(Wardwell Braiding Machine Co., U.S.A.)

mated to the gear and secured in position with a set screw (Fig. 69).

Gear centres are varied by means of a quadrant bracket.

4.8. Spools

Definite proportions for spools are issued by the makers and to exceed these dimensions can cause a certain amount of trouble. It is not by

any means an uncommon sight to witness a machine working with odd spools or spools with too long a traverse.

Usually it is a case of some one far removed from the site of braiding operations ordering spools from suppliers for quick delivery or cheapness. The inevitable result of using these oversize spools is poor braiding and greatly increased cost due to innumerable stoppages.

4.9. Wire Braiding

A limited range of wire braids can be produced on the "Wardwellian". Special parts can be obtained for this work and subject to a little extra care being taken first class braids are possible. Depending mainly upon the nature of the wire and the type of braid running speed will have to be reduced.

Two typical examples of how speeds can vary to suit circumstances are given – Standard braid, 24 carriers, 8 ends, tinned copper wire .012" dia. running speed 60 R.P.M.

Standard braid 16 carriers, 4 ends plain annealed copper .0076" dia. running speed 90 R.P.M.

An end is a single strand of wire regardless of the length. This brings us to what is one of the most difficult problems connected with wire braiding – multi- end spool winding.

To wind several ends of wire simultaneously and maintain a constant and uniform tension on each wire throughout the winding of the spool has always been a formidable problem. One, two or three ends of soft copper wire can be wound on to a spool with conventional winding machines and reasonable results obtained if care is exercised.

As often as not however it is common place to find that five or more ends are required for a braid and this creates difficulties where normal winding gears are concerned.

If when commencing to wind a spool of wire, snarls or crossed wires are made with the first few turns on the barrel of the spool it will become almost impossible to complete the spool in a satisfactory manner. Often an inexperienced operator will secure the starting ends of wire to the spool barrel in a crude fashion and the irregularity so produced will be visible when the winding is completed.

A certain amount of latitude can be tolerated when spools of wire are being wound for some maypole braiders but it is absolutely essential to obtain a firm clean winding for high speed machines.

Winding gear should be designed for gradual starting. A sudden start or any tendency to snatch will cause trouble and with fine wires there

may be breakages. Both let-off or supply reels and braider spools should be maintained in good condition.

It is virtually impossible to obtain a good winding with a braider spool that does not run true and it is equally difficult to maintain a uniform tension with a damaged or out of balance let-off reel. Some form of braking is also necessary with let-off reels to prevent over-running when the winding gear stops.

Serious and successful efforts to overcome some of these wire winding difficulties are to be seen in the recently designed multi-end wire winding machine built by James Day (Machinery) Ltd. Fig. 70.

Known as the "Ensor" winder and named after the designer, this machine, which is both novel and unconventional, represents a definite advance in the technique of multi-end winding. Another interesting machine with similar objectives – precision multi-end winding is being

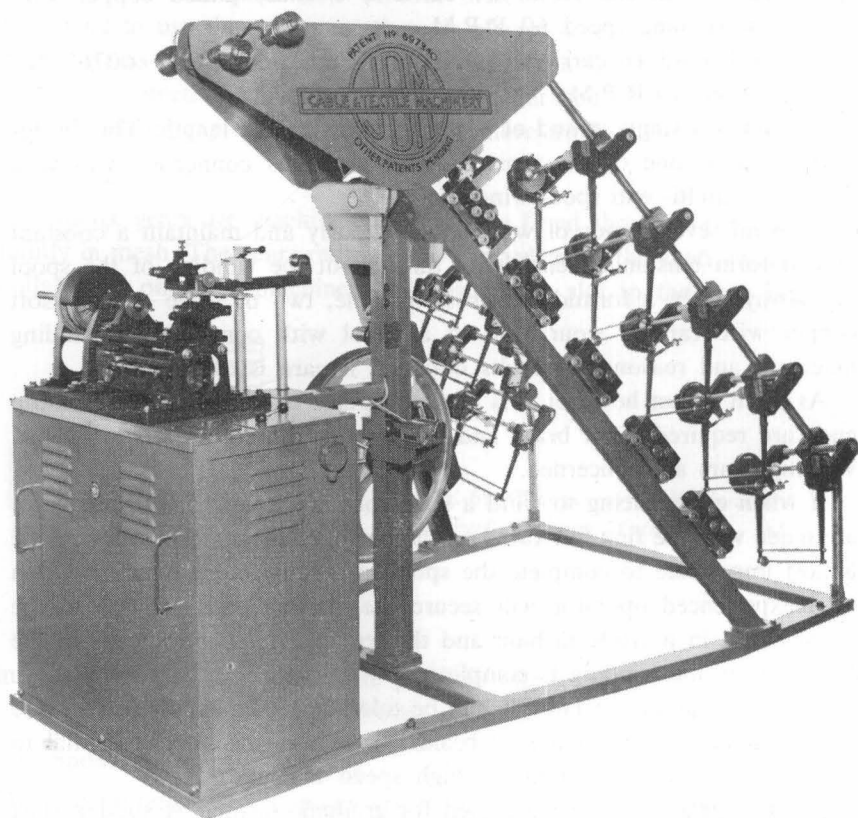


Fig. 70. Multi-end winding gear (*James Day Machinery Ltd, London, England*)

produced by W. & M. Ostermann (Germany). Both these machines cater for the heavier types of wire used for braiding.

For fine wires from .001" to .012" dia a cleanly designed and very efficient winding gear is shown in Fig. 71.

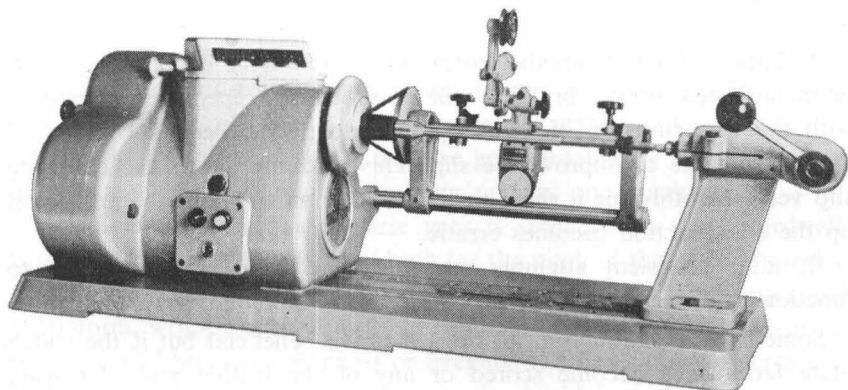


Fig. 71. Fine wire winding gear (*Willy Aumann, Germany*)

Primarily produced for coil winding this machine by Willy Aumann K.G. Germany can be readily adapted for multi-end winding. Foot control, slow start, traverse that can be easily adjusted by means of a clearly marked dial to suit any size of wire or wires within the range.

Built in turn counter that can be set to automatically shut the machine off when the required number of turns are wound. A unit system of let-off stands, with graduated tensioning can be linked up with the winding gear and in the rare event of a broken wire the winder is stopped immediately. This winding gear represents a definite improvement in the technique of multi-end wire winding.

With high speed braiders, weights have to be considered and in the case of the "Wardwell" it is recommended that the combined weight of a single carrier spool and wire should not exceed certain set limits. In the interests of maximum capacity wire is usually layer wound, and for this reason wire spools have to be strongly constructed. Another point to be watched in connection with rapid braiders is that wire spools should always be of approximately the same proportions and loaded with a reasonably uniform quantity of wire in order to avoid undesirable out-of-balance effects when the machine is running.

4.10. Let-off and Take-up Reels

When using reels for both supply and reception, extra care is needed,

especially when braiding wire. A badly set-up reel, or one that is out of balance or buckled is often the cause of poor uneven braid. The take-up capstan on the braider is positively driven and an adjustable brake is fitted to minimise the effects of backlash in the gear train and maintain a reasonably steady tension between the take-up capstan and the reception reel.

A slipping clutch drives the reception reel and if the clutch is neglected or maladjusted, erratic braiding will be produced. Operators, unfamiliar with the true function of the slipping clutch, have been known to oil the clutch faces to improve the slip. This certainly allows the clutch to slip very smoothly for a short time, but as soon as friction dries the oil up the clutch action becomes erratic.

If, after persistent attempts at adjustment, the clutch continues to function erratically it should be completely dismantled for examination.

Sometimes a thorough clean up will prove beneficial but if the clutch plate faces have become scored or any of the leather pads damaged, a new plate complete with a set of leather pads is the easiest remedy.

Some "Wardwellians" are equipped with an adjustable spring loaded, short centre, slipping belt drive instead of the clutch previously described and providing an endless belt without metal fasteners is used the set-up is comparatively trouble free.

Another difficulty encountered in the cable and wire industry is creep or slipping on the take-up sheave.

The combination of a springy hard drawn wire core and a wire braided sheath usually has a marked tendency to slip on the take-up capstan.

It should be remembered that in cases like this the braided product is wrapped several times round the take-up capstan and the natural reaction of any coiled wire when wrapped on a mandrel is to open slightly. Thus a slight variation in slip and the turns on the capstan will open, slip on the capstan and then pull taut thus creating a variation in the braid formation.

A layer of coarse tape wrapped round the take-up capstan will help to minimise this tendency but it is extremely difficult to entirely eliminate this form of trouble.

At one time, almost any reel that could be put into service would be used for reception purposes and some very crude methods were used to drive these odd sized reels, the effect on the finished product-inferior braiding. Fortunately this tendency is disappearing, the general trend nowadays is to use standard reels for processing thus avoiding much of

the trouble arising from the use of unsuitable reels and rough and ready drives.

4.11. **Traverse or Flaking Gear for Reception Reels**

Auto-traverse or flaking gears are an essential feature of high speed braiding, providing the means whereby the finished product, such as wire or cable is uniformly wrapped on to the rotating reception reel.

Many ingenious traverse arrangements are in use but there is such a wide diversity of shapes and sizes in the cable industry that it is virtually impossible to design a traverse gear suitable for the entire range of products that may require braiding on any one machine.

A simple and effective traverse gear is standard on the "Wardwell" braider. It is quite easy to adjust both for the pitch of the braided product and also for width of reel up to the maximum limits of the take-up stand.

Uniform wrapping is a most desirable feature for any take-up or reception reel because unevenness or irregularities can cause an occasional slight snatch-sufficient to upset the regular braid formation.

4.12. **Setting-up**

Attention to detail and a certain amount of care is required when setting-up any rapid braider for wire.

Carriers must be threaded up correctly and tensions must be correctly adjusted to suit whatever wire is being processed. As each carrier is loaded a check should be made to ensure that all working parts are functioning with perfect freedom. The position of the braiding die or centre usually needs some adjustment and in the case of the 16 carrier "Wardwell" the distance between the undersurface of the calipers and the top of the beater tube should not exceed $\frac{5}{8}$ " or .625". The wire supply from each lower carrier in turn should be pulled smoothly and fairly rapidly from the spool, passed through the braiding die and then tied to the haul-off capstan. When pulling the wire supply from the carrier, observe whether or not there is excessive bouncing by the lower supply tension lever. Adjust the tension so that bouncing is reduced to a minimum.

With fine wires a simple method of checking can be made after all the wires are set up. Bunch all the wires together and twist them round the index finger just above the braiding die. Pull upwards for about twelve inches or so and if all the wires pull through smoothly and comfortably it is reasonable to assume that braiding can commence. When starting new spools or fresh ends the wire should be laid in correct sequence.

If from an upper carrier it should be taken round the core in the same direction as the rest of the upper carriers.

The same thing applies to wires from lower carriers.

Failure to adopt this precaution will produce an untidy snarl and ruin the appearance of the braid.

Fig. 72 shows the correct method of threading an upper carrier. It is

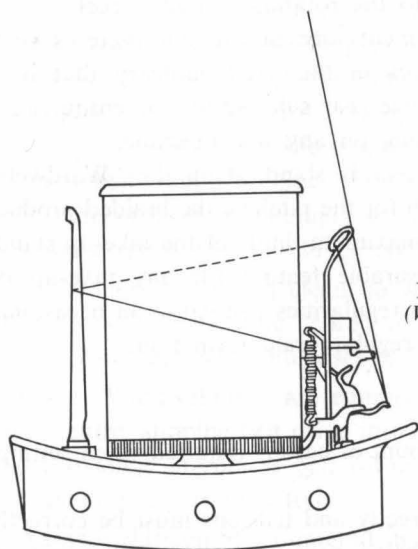


Fig. 72. Carrier threading "Wardwellian"
(Wardwell Branding Machine Co., U.S.A.)

very common to find that instead threading up in the correct manner, the yarn or wire has been taken from the spool straight to the top thread eye on the tension stand at the front of the carrier.

Admittedly the braider will run with carriers threaded up in this manner but to do so increases the tendency for foul turns and erratic tensioning.

4.13. European High Speed Braiders

Whereas the "Wardwellian" braider incorporates a fixed deflection system for yarns or wires the majority of machines of European origin use a combination of fixed guides and rocker arms for passing the yarns or wire over and under the upper carriers. A compound circular rack and pinion system for upper carrier propulsion coupled with an undulating cam ring for providing the motion to the rocker arms tends to make the machine elaborate and bulky.

Subject however to the usual precautions of cleanliness and attention to detail when setting up, this type of high speed machine is an excellent braid producer.

Fig. 73 shows two horizontal 24 carrier braiders of this type built by Th. Spirka K.G. of Germany.

The subject of the next illustration Fig. 74 is a 16 carrier rotary braider produced in England by B. & F. Carter.

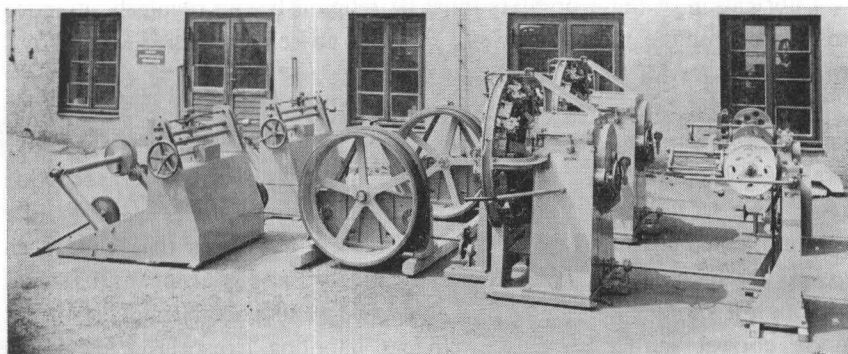


Fig. 73. High speed rotary braiders (*Th. Spirka K.G., Alfeld-Leine, Germany*)

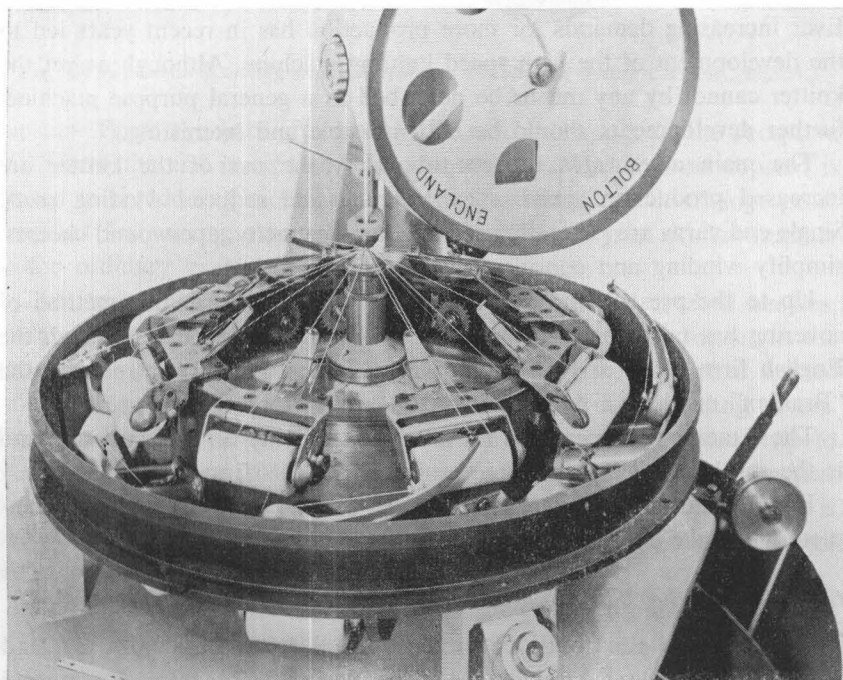


Fig. 74. High speed rotary braiders (*B. & F. Carter, Bolton, England*)

The simplicity of the carriers and the disposition of the carrier propulsion gearing, rocker arms etc, are clearly seen.

Information regarding the origin of this type of braider is rare although it seems that the Guido Horn machine was the forerunner of all the braiders designed in this manner.

Lubrication of these braiders must be religiously and regularly attended to because unlike the "Wardwell" there is no self contained splash feed to compensate for an oversight.

As with all high speed machines the problem of stopping quickly for yarn or wire breakage has made necessary the introduction of an effective braking system. Auto-traverse, and slipping clutch drives for reception reels have to be used and all these refinements tend to give the braider a complicated appearance. Most of the operational tips that have been given about the "Wardwell" also apply to these European machines although it should be remembered that good results are always dependent upon correct setting up and intelligent handling irrespective of design or country of origin.

4.14. The Knitting Machine for Cable and Wire Covering

Ever increasing demands for more production has in recent years led to the development of the high speed knitting machine. Although as yet the knitter cannot by any means be described as a general purpose machine, further developments should be both possible and interesting.

The main advantages brought about by the use of the knitter are increased production speed, silent running and reduced winding costs. Single end yarns are generally used and large capacity taperwound cheeses, simplify winding and considerably reduce down times.

Up to the present, most of the development work on this method of covering has taken place in America (Fidelity Machine Co. although the English firm of B. & F. Carter of Bolton have recently introduced the "Braidex" machine a two head vertical knitter for cable covering.

The American process is known as the "Fidelity Sinfra" covering and is the result of considerable pioneer work by this firm in Philadelphia.

Fig. 75 shows a standard three head "Sinfra" covering machine complete with take-up gear and yarn creel.

Operation of the "Sinfra" Machine

To set up, the wire to be covered is pulled from the supply reel and passed through a wire straightener at the rear of the machine. It is passed through the three knitting heads and wrapped six times round the haul-off

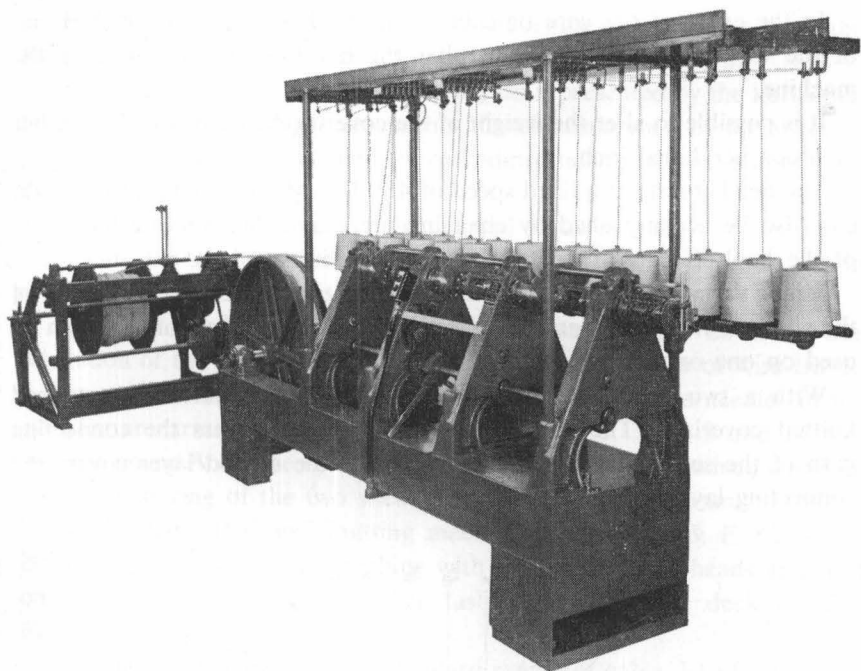


Fig. 75. American Knitting Machine (*Singer Fidelity Machine Co. Inc., U.S.A.*)

capstan. From the haul-off capstan the wire then goes to the reception reel where the end is secured ready for starting. The haul-off capstan is geared to the driving motor and rotates a constant speed. Change gears are used for varying the speed to suit conditions, in a similar manner to the ordinary braiding machine.

The three knitting heads, each fitted with 12 or 14 latched needles, rotate at the same speed and the centre head of the three rotates in the opposite direction to the remaining two heads, so that the spiral knitted covers cross each other and cover the interstices of the preceding covers. Single end supply yarns wound in cone form and weighing from two to five pounds each are placed in position on the supply stand at the rear of the machine. These cones of yarn remain stationary and the yarn is pulled from over the small end of the cone by the combined motion of the core and the needles.

Each yarn is passed through an individual electrical stopping device and the machine cannot be started if a yarn is broken or left out.

A curved bar above the wire straightener is fitted with a roller that rides on the wire as it enters the machine.

In the event of the wire or cable being broken, or if the finished end of the wire passes beyond this roller the bar falls down and stops the machine.

It is possible to alter the weight of the covering by changing the number of loops per lineal inch.

The heads rotate at a fixed speed of 480 R.P.M. and a change in weight can also be accomplished by changing the gears, thus varying the speed of the haul-off capstan in relation to the knitting heads.

Minor variations can be made by increasing or decreasing the length of the stitches. If major changes are needed, different counts of yarn can be used on one or more of the covers.

With a two head knitter the sheath will consist of two intertwined knitted coverings. The stitches of the first layer covers the connecting yarn of the second layer and the stitches of the second layer covers the connecting layers of the first covering.

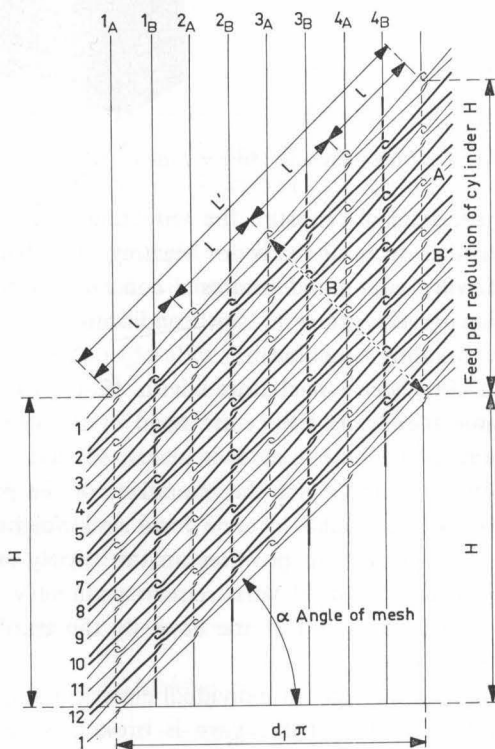


Fig. 76. Stitching pattern (*Singer-Fidelity Machine Co. Inc.*)

Imagining one of the knitted covers slit lengthwise with the wire and flattened out, the resulting stitch pattern is shown in Fig. 76.

In the diagram there are eight ends of yarn represented by the horizontal lines. The vertical distance represents the circumference of the wire, so that the wire can be imagined as extending indefinitely in a horizontal direction.

The angle shown on the left is referred to as the angle of mesh and represents the angle that the spiral pattern makes with a cross section of the wire.

The diagram shows graphically the symmetry of the cover in one revolution of the needle cylinder with an assumed distance of wire travel.

The two coverings are marked A and B and the twelve needles in the cylinder are arranged in two groups. Needles 1, 3, 5, 7, 9 and 11 will produce cover A and needles 3, 4, 6, 8, 10 and 12 will produce cover B. The interweaving of the two sheaths is shown in the diagram.

The English "Braidex" knitting machine made by B. & F. Carter of Bolton, Lancs is a vertical machine with the two knitting heads arranged one above the other in a similar fashion to a double deck braider. Fig. 77.

Designed for covering certain standard ranges of cable, let-off and take-up reels are accommodated in easy lift stands, arranged in line at the base of the machine.

No wire straightener is provided because the machine is intended to be used for cable covering only.

The core to be covered is taken from the let-off reel to the haul-off capstan. Three or four turns are made on the capstan and the core then passes down through the knitting heads and round an off-set guide pulley lined up underneath the heads. From there it goes up behind the knitting heads and over another pulley mounted level with the haul-off capstan. From this delivery pulley the core goes to the reception reel which is provided with automatic adjustable traverse gear.

16 Cones of single end yarn are used on this knitter, each yarn is lightly tensioned and passes through an electric stopping device which halts the machine in the event of yarn breakage or run out.

A warning light indicates to the operator either a broken yarn or when the end of the cable to be covered is finished.

For safety reasons the electrical cut out system is operated on a low voltage supply incorporated in the machine. A handwheel in front of the machine enables the operator to manipulate the knitter for setting up or adjustment.

The main advantages claimed for this machine are silent running, high output – three to five hundred yards per hour and long runs without the necessity of re-spooling.

It should be emphasised, however, that the knitter is a special purpose machine, produced for covering certain standard sizes of cable only.

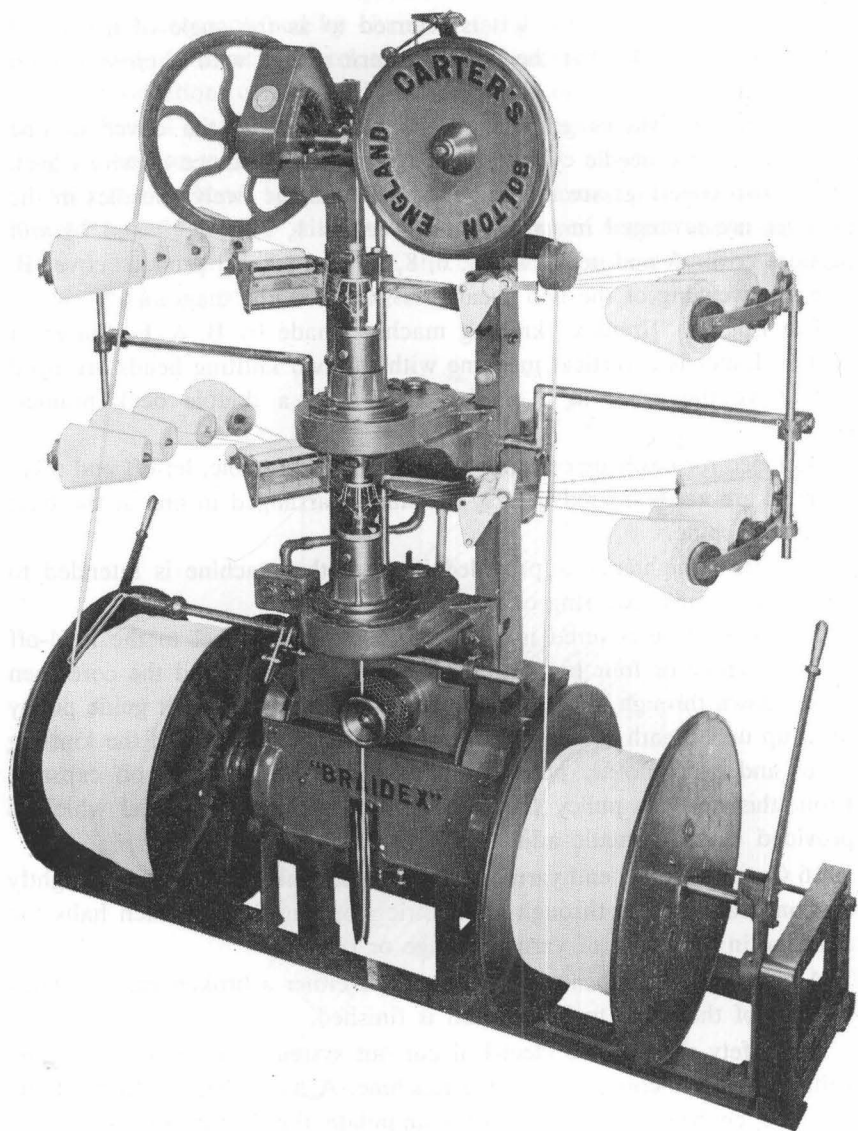


Fig. 77. English knitting machine (*B. & F. Carter, Bolton, England*)

4.15. A short survey of braiders (European and American)

From Germany

A high percentage of the machines of German design are of the carried carrier type and the main centre for the production of fancy plaited work seems to be Wuppertal-Barmen. Early records of braiding machinery are somewhat scanty, but it appears that mechanical plaiting originated in 1748 in Manchester.

Soon after this, machine braiding transferred to France and during the French revolution it was taken by French immigrants to Barmen in Germany where eventually it developed into an important industry. Before long, other centres in Germany began to specialise in braid and lace making machines and such names as Johann Fries, W. Reising, W. & M. Ostermann, Emil Krenzler and August Herzog became familiar all over Europe.

The machines produced were many and varied-ranging from simple three thread braiders to machines with several hundred carriers for fancy braids.

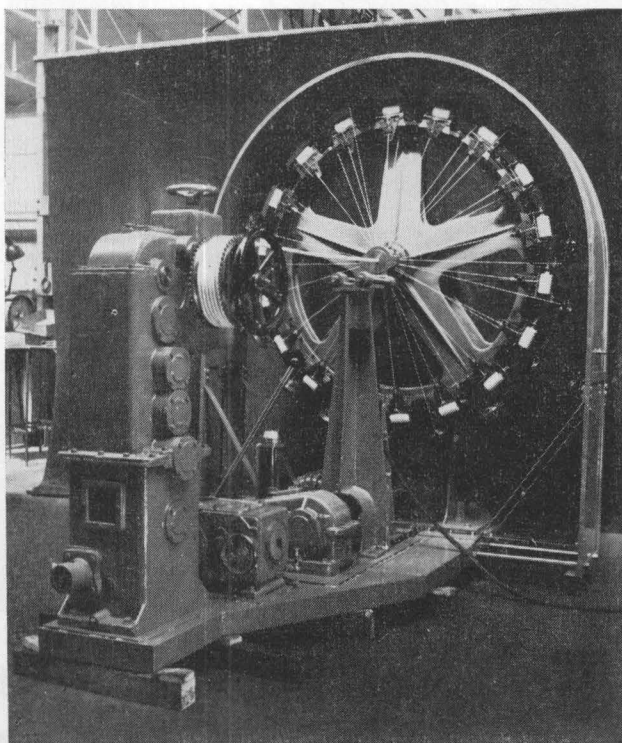


Fig. 78. Horizontal high speed braider (*W. & M. Ostermann, Germany*)

The firm of August Herzog of Oldenbourg cater for at least five hundred different types of braiding machines and although braiders are basically similar in many respects, mass production except for certain details is out of the question.

Many manufacturers of braiding machines produce a range of standard machines usually with 12, 16, 24 or 36 carriers (tubular) or 13, 17, 21, or 25 carriers (flat). In Germany, however, the trend is to build braiders to suit any requirements, and this results in an extensive programme. High

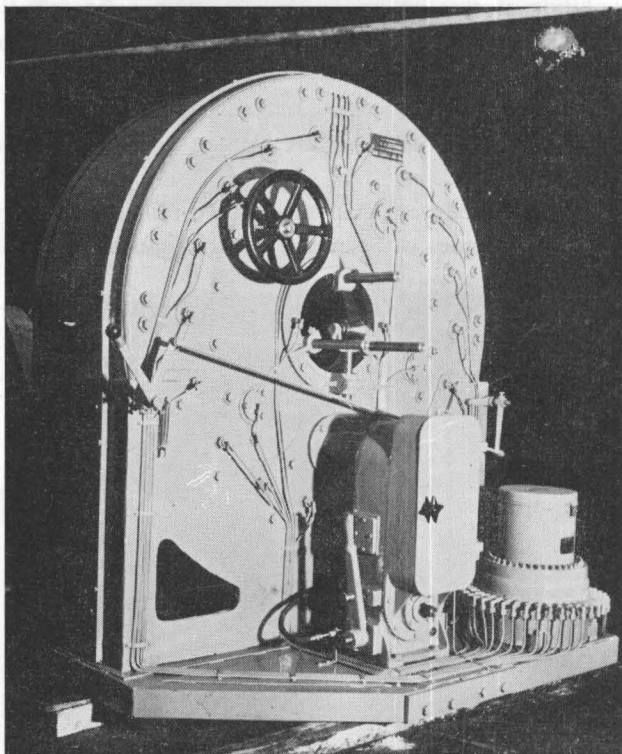


Fig. 79. Centralized pressure lubrication (*W. & M. Ostermann, Germany*)

speed German braiders are of the "Guido Horn" type produced by Th. Spirka and W. & M. Ostermann. The first named firm specialize in rapid braiders but W. & M. Ostermann make a wide range of maypole machines as well as rapid machines. Fig. 78 shows a 36 carrier horizontal braider of the "Horn" type produced by W. & M. Ostermann.

A feature of Ostermann maypole machines is the use of a pressure fed, centralized lubrication system. With the older types of braider the lubri-

cation of horngear pins or bushes was all too frequently left to chance. When several hundred braiding machines are in regular use it is easy for attendants or operators to miss out some of the horngear pins or bushes. An oversight of this nature can result in an expensive seizure and in extreme cases may result in loss of production for several days.

With pressure greasing a container with some form of pump is mounted in a convenient position and piping runs from the container to all the horngear bushes and vital points that normally require periodical attention.

In effect, this is simply a multiple grease gun system that functions when the machine is working, thus ensuring that these vital bearings are adequately supplied with lubricant.

There is of course the remote possibility that one of these feed pipes may become choked, but this would be extremely unlikely. Fig. 79 shows a horizontal braider equipped with central lubrication.

A battery of small unit driven braiders for cable and wire covering is shown in Fig. 80 (A. Herzog, Germany).

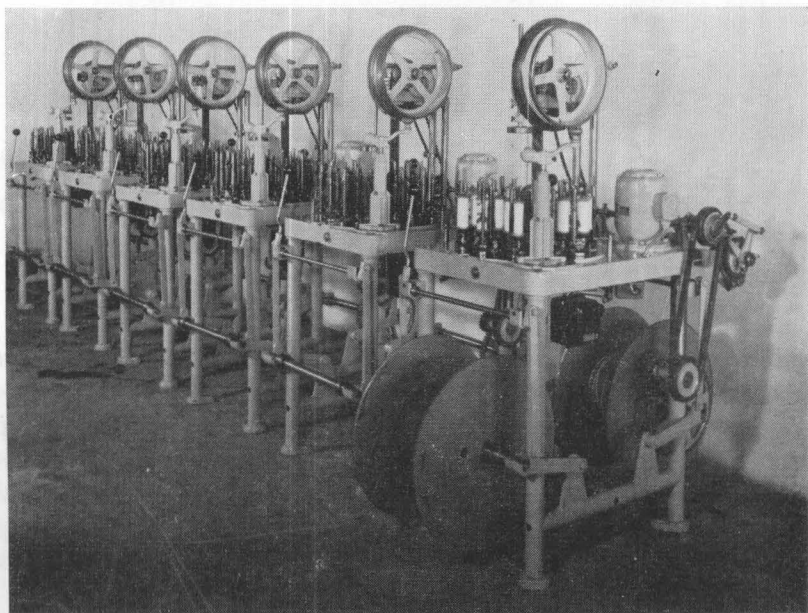


Fig. 80. Unit driven braiders (A. Herzog, Germany)

From France

As in most countries the manufacture of braiding machinery is limited to one or two reputable firms. A wide range of machines are available

from E. Brondel of Lyons. Sturdily constructed and embodying some unusual and novel features it is obvious that careful thought has been given to the design and manufacture of both textile and wire braiders.

Carried carriers for these machines are of the twin swivelling track follower type (Fig. 81).

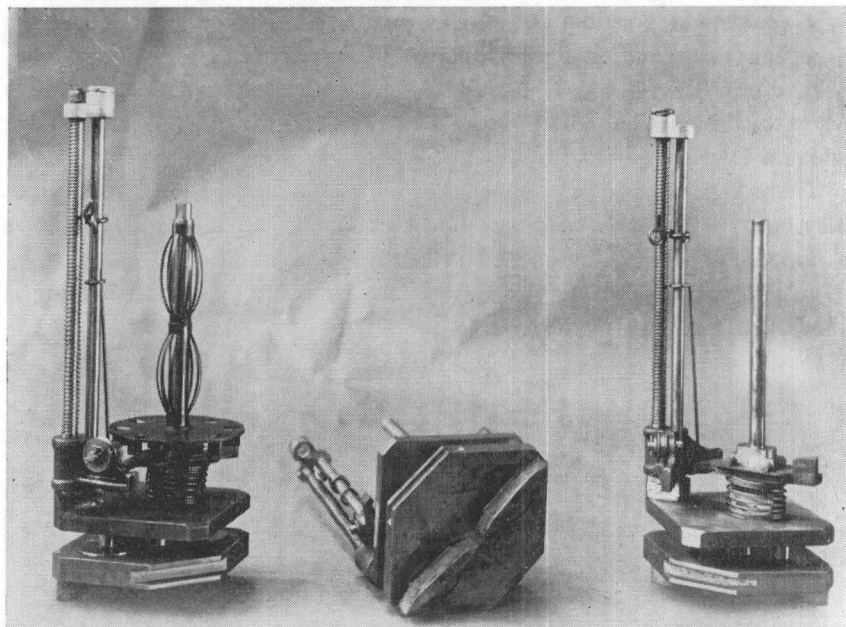


Fig. 81. French carriers (*E. Brondel, Lyon, France*)

Three standard ranges of machine are manufactured by Brondel and these are built in two sizes.

For textile work machines are built with 12 to 40 carriers in steps of four. The two sizes are: —

1. Carriers to take spools 50 mm dia $\times$ 120 mm long.
2. Carriers to take spools 85 mm dia $\times$ 150 mm long.

Instead of the normal horndog slots there are three recesses for each carrier. The central recess which in the largest, accommodates the main carrier lug and two shallow recesses on either side of the main slot are designed to receive the shanks of the swivelling boats or track followers. (Fig. 23 Page 29).

Sliding friction is reduced to a minimum and horngear tuning extremely accurate.

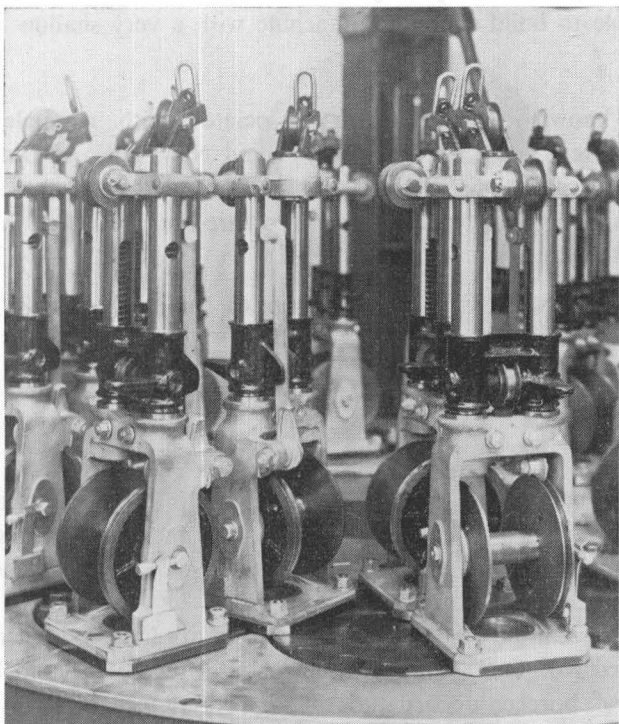


Fig. 82. French wire carriers (*E. Brondel, Lyon, France*)

By distributing the carrier base loading in this way wear in reduced and increased running speeds become possible. For example a normal 4" horngear 16 carrier slide braider would run at 60 to 65 convolutions per minute whereas a Brondel braider of similar proportions would convolute at 80 per minute. Lastly wire braiders, and examination of Fig. 82 reveals some novel features. Detachable bases, partially enclosed tension springs and friction controlled wire supply release. These are all in keeping with modern design trends.

From Italy

The programme of Federico Dick covers an extensive range of maypole machines and includes jacquard controlled braiders for the production of ribbon lace.

An unusual type of horngear is found on many of these machines

inasmuch as the hornsloths are formed in the gear. When carrier transfer takes place the bottom lug of the carrier absorbs part of the load that would normally be taken by the gear teeth. With this method of construction it is possible to build a braiding machine with a very shallow deck.

From U.S.A.

Two well-known American firms associated with maypole braiding machinery are Textile Machine Works and New England Butt. Co.

Standard braiders with up to 96 carriers are built on a semi-mass production basis and the types fall into three main groups in the New England Butt programme.

Standard No. 1. – Small Braiders for spools $1\frac{5}{16}" \times 3\frac{1}{4}"$ traverse.

Standard No. 2. – Braiders for spools $1\frac{7}{8}" \times 3\frac{1}{2}"$ or 5" traverse.

Special. – To suit customers requirements.

Machines can be equipped with top or bottom weight carriers or if required. Mosspeed or Hagg, carriers can be used to increase output. Braiders with 32 or less carriers are fitted with shot legs and generally this type of braider is for use on a bench or table.

Copholders can be obtained for use on any machine and when supplied for standard No. 1 or 2 braiders the material or yarn should be wound on to a $\frac{5}{8}"$ bore cardboard tube of appropriate length.

Recommended speeds of standard braiders under average circumstances and using "Mosspeed" carriers.

Horn gear Speed 256 R.P.M.

Convolutions as below: –

16 carrier	–	64	C.P.M.	C.P.M. = Convolutions per min.
20	„	–	51.2	„
24	„	–	42.6	„
36	„	–	28.4	„

Standard No. 1. Flat Braiders are built with 7, 9, 13, 17, 21, 25, 29 carriers and Tubular Braiders with from 8 to 32 carriers in steps of four. Large Standard No. 1. Flat braiders are built with 33 to 89 carrier in steps of four and Large Tubular machines with 32, 36, 40, 44, 48, 52, 56, 64, and 96 carriers. Eleven types of feed mechanism are available, any of which are inter-changeable on the range of braiders for which they are suited.

In addition there are standard heavy machines which can be fitted with wire carriers (Fig. 83). These wire carriers have a low centre of gravity and can be obtained with or without a detachable base.

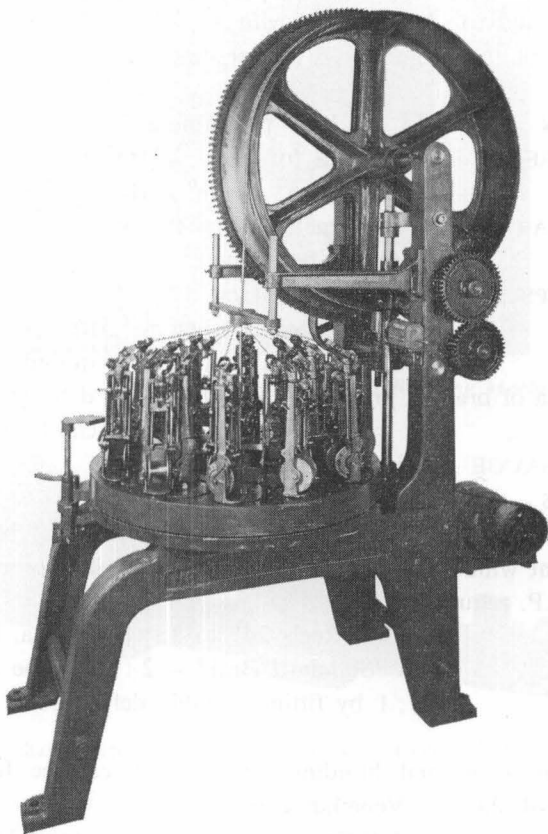


Fig. 83. American wire braider (*New England Butt Co., U.S.A.*)

The braider illustrated is a 24 carrier 6" horngear machine. Large capacity pressed steel spools are used in conjunction with the carriers and a detachable ratchet supply regulator is fitted to the spool when ready for insertion into the carrier.

Spring tension can be varied by changing springs to suit.

This system of spring changing is advantageous because it simplifies carrier design, and eliminates the danger of maladjustment on the part of inexperienced braiding machine operators. A readily adjustable tensioning device on a braider carrier, can give rise to difficulties.

Textile Machine Works produce some sturdy reliable braiders a number of which have been previously described.

The "Wardwellian" rapid braider is probably the most familiar of American braiders. Made on a mass production basis this machine is for tubular work and can be obtained with 12, 16, or 24 carriers.

Particulars of the standard 16 carrier machine are as follows:

PRODUCTION -	24" to 126" per minute.
CARRIER SPEED -	Maximum for yarns - 160 R.P.M.
	" " wire - 100 R.P.M.
DRIVING GEAR -	7" dia. metal to metal cone clutch. Pulley to suit flat or V belt drive.
TAKE-UP CAPSTAN -	18" dia $\times$ 3" face.
CAPACITY -	Standard beater opening .5625". Special beater .8125" can be supplied if required.
Maximum Dia of braided product -	.5" with standard beater
" " " " " "	-.6875" with special beater.
MAXIMUM GAUGE	Wire for Braiding = .012".
YARN PACKS -	Universal Wound 2.6875" dia $\times$ 4" traverse wound on cardboard tubes .625" bore
	3 point wind for cotton 4 point wind for rayon.
Maximum H.P. required - $\frac{3}{4}$.	
STANDS -	to suit Reels 24" to 36" flange dia. Max traverse 16" Standard Braid - 2 : 2 can be converted to 1 : 1 by fitting suitable deflectors.

In addition to normal braiding, attachments can be fitted for the manufacture of shoe or Venetian cord.

By reducing speed and fitting wire guides it is possible to produce certain ranges of fine wire braid.

S or Z yarn wrapping can be undertaken with a range of eight colour combinations. Fig. 84 shows a standard 16 carrier machine for cable and wire covering.

From England

As in most countries the manufacture of braiding machinery is confined to a few firms of repute, Messrs. B. & F. Carter of Bolton have a very extensive range of standard machines for all purposes. For heavy duty braiders with horn gears over 6" in diameter, this firm is world famous.

Fig. 85 shows a 3 head horizontal wire and yarn braider.

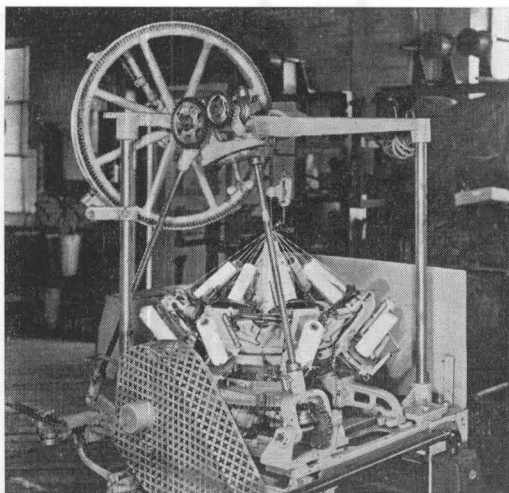


Fig. 84. American "Wardwellian" braider (*Wardwell Braiding Machine Co., U.S.A.*)

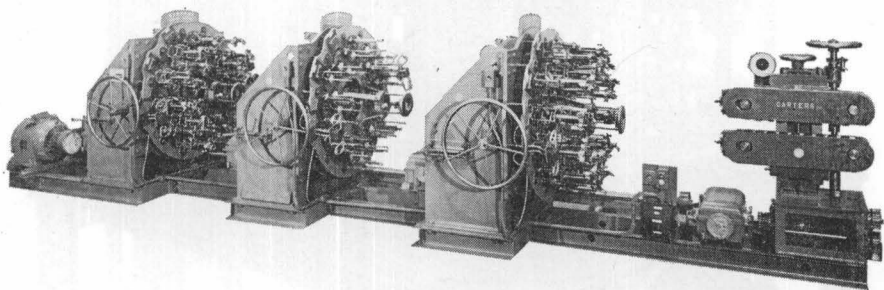


Fig. 85. 3 Stage yarn & wire braider (*B. & F. Carter, Bolton, England*).

The front and rear decks, each have 24 "Max" wire carriers and the centre deck 24 yarn carriers. Diameter of horngears 7.48' A.P.I.V. gear is incorporated on each head and the haul-off which is a twin grip caterpillar.

Fig. 86 illustrates a 15 carrier flat braider and it is interesting to note that weighted carriers are used in this machine.

Some sturdily constructed slide plate braiders are produced by Messrs. J. B. Hyde of Wythenshawe, Manchester and these braider are of Textile Machine Works U.S.A. design.

Track and quoit plates for these machines are of high grade steel. These tracks stand up to the harsh conditions of service extremely well, and provided the plates have not been allowed to wear to the extreme, transfer points can be renewed by welding.

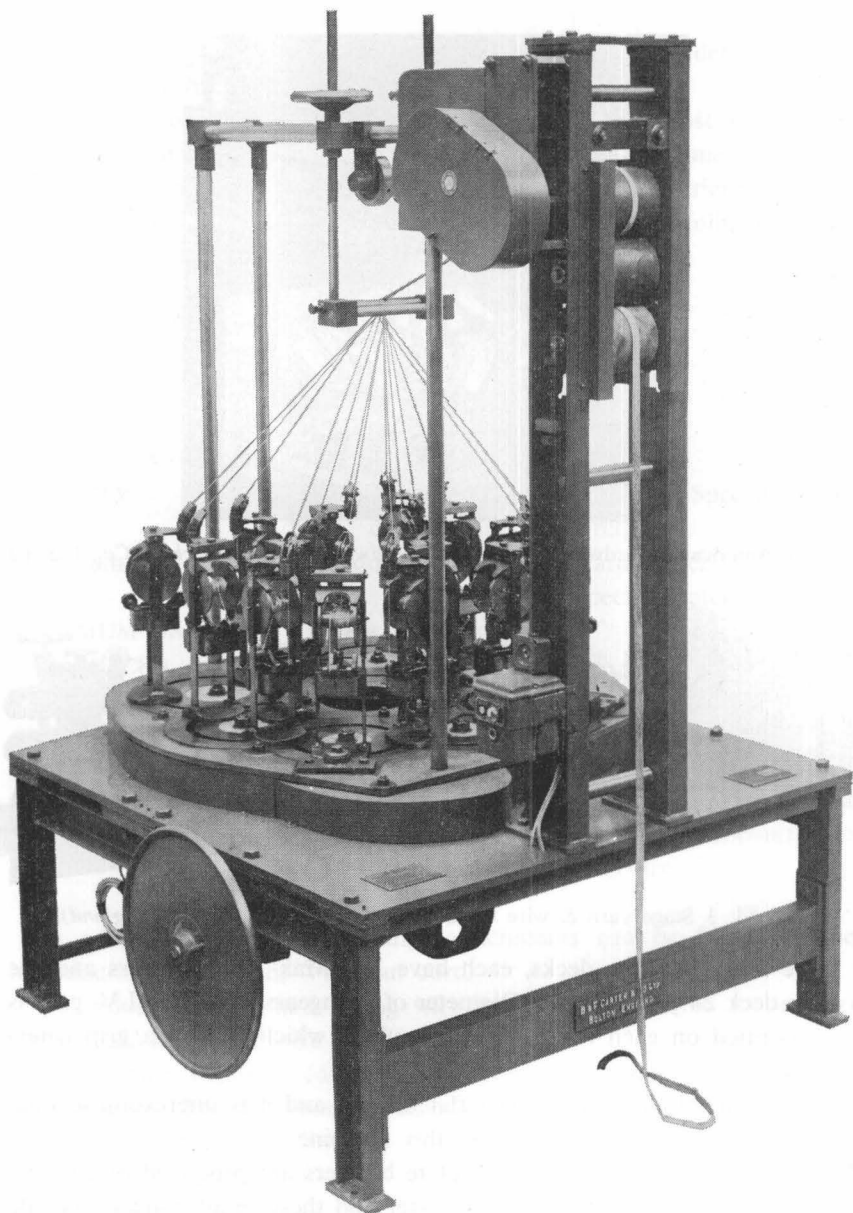


Fig. 86. 15 Carrier flat braider (*B. & F. Carter, Bolton, England*)

Hobourn Aero Components Ltd. of Rochester specialise in the manufacture of table and bench braiders mainly for the elastic trade. Precision built, single or twin head, self contained unit driven machines can be

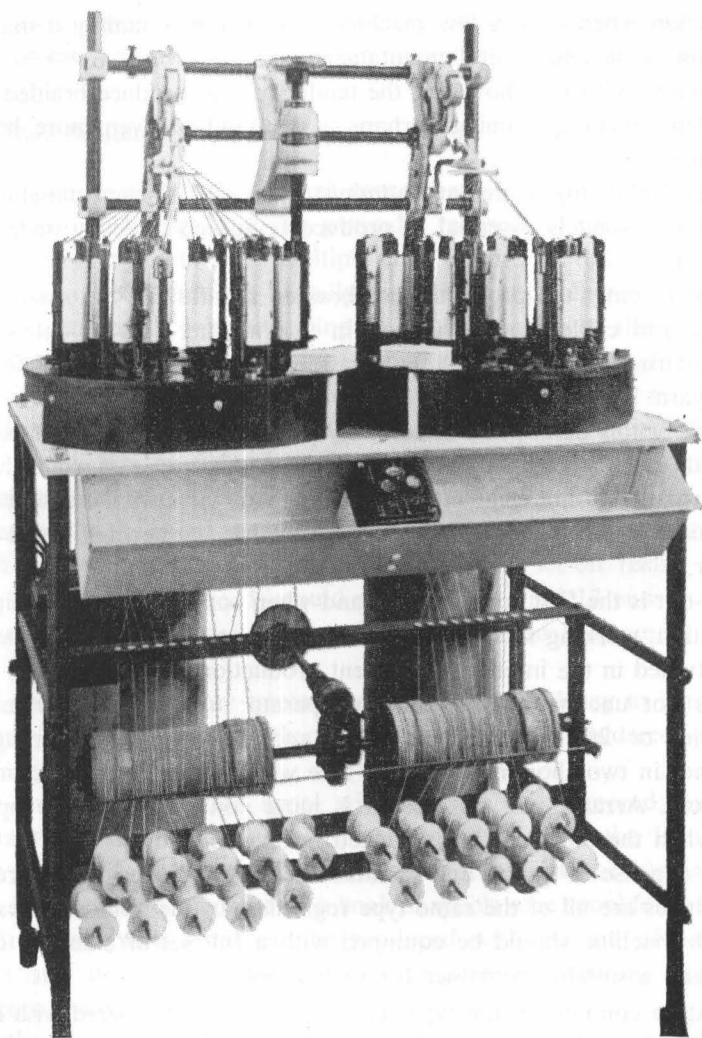


Fig. 87. Twin head flat braider (*Hoborn Aero Components Ltd., Rochester, England*)

obtained for flat or tubular work with any number of carriers from 8 to 49. Machines for elastic work are fitted with an ingenious let-off creel for rubber threads.

4.16. Quantity Production of Braid

Up to now the features and problems associated with braids and braiding machinery have been referred to more or less on a unit basis. Efficient

production when only a few machines are in use is mainly a matter of common sense and careful maintainence.

In many industries, however, the tendency is to produce braided goods in a department containing perhaps a thousand or even more braiding machines.

Careful planning, systematic administration and efficient maintainence, these are absolutely essential to produce braid economically under these conditions.

Until recently the production of braided sheaths for the smaller sizes of wire and cable was carried on in this manner but the introduction of the extruded plastic sheath has considerably reduced the need for large scale yarn braiding.

Work of this description is normally produced with the aid of batteries of small machines of various types. The most popular machine for this work was the 4" horngear maypole braider but the ever increasing tempo of modern production has led to increased use of the high speed rotary braider.

Lay-out is the first consideration and when contemplating this, lighting, ventilation, working space and reel accommodation all this must be carefully studied in the interest of efficient production.

It is not uncommon for a single operator to attend to 40 maypole machines or 20 high speed braiders and it is better to arrange the machines in two short rows face to face with ample gangway room back and front. Arranged in this way it is more convenient for the operator than when the machines are arranged in one long row.

The expense of spares and maintainence will be considerably reduced if machines are all of the same type regardless of the number of carriers.

Each machine should be equipped with a full set of standard change gears and a suitable container for yarn spools.

Yardage counters of the type that are not easily tampered with should be fitted to each braider with the double advantage that lengths can be checked and useful information regarding output will be registered. Maypole braiders are necessary for general work and high speed rotary machines could be used with advantage for certain standard classes of braid or urgent orders.

Damaged spools should be put aside for either attention or scrapping. Cleanliness and systematic attention to lubrication are important and any mechanical defects should be promptly rectified whenever they are noticed.

It would be useful to have all the carriers in a machine clearly numbered as on the "Wardwellian" braider. This can be of great assistance when

tracing faults and if for example a succession of yarn breakages occur it is much easier to trace the fault when individual carriers are identifiable.

4.17. Wire Braiding

Inferior spool winding causes a high percentage of the difficulties associated with wire braiding. It is not generally realised how much skill and patience are required to wind multiple ends of wire on to a single spool.

Production personnel are usually impatient and all too frequently suggestions are made without giving due consideration to the problems. Remarks such as winding three spools simultaneously or, a single operator can easily manage six winding heads are made with little or no thought about the nature of the wire, or the condition of the winding gears or spools. Supposing for example a thirteen end, twenty four carrier braid is required, and this is by no means uncommon. To wind three spools simultaneously, the spools would have to be made to precision limits, and tension controlled strands would be needed for 39 let-off reels.

Similarly six winding heads would mean that to wind 13 ends, it would be necessary for the operator to carefully adjust and keep under observation 78 let-off reels.

The above examples are quoted because of the tendency to ignore the existence of multiple ends when winding is being considered for the manufacture of braid.

The importance of good spool winding cannot be ignored and how important this is can be gauged by the introduction of the latest wire carrier produced by W. & M. Ostermann for precision braiding. This carrier is designed to accomodate a bank of spools -one spool for each end.

A first class wire braid can be produced with the aid of weighted carriers and it is sometimes worthwhile sacrificing running speed to produce a really good braid.

Another common source of broken wires is an accumulation of slack turns on the outer layers of wire on the carrier spool.

Carelessly inserted carrier spools or faulty tensioning are two reasons for this occurrence.

For coated wire such a tinned or nickel plated copper a close fitting braiding die should be avoided because there is a tendency for minute quantities of the plating to scrape off and accumulate on the die faces.

Under these circumstances it is possible for the die to foul sufficiently to rupture the braided product.

When dealing with coverage present day trends are to work to a filling

factor. Results are seldom satisfactory, however, because a good filling factor rarely coincides with maximum output requirements.

Formula for the filling factor is given below: —

$$\frac{mnd}{2\pi d} \left(1 + \frac{\pi^2 D^2}{L^2} \right)^{\frac{1}{2}}$$

D = Mean diameter, of braid

d = Mean diameter, of braid wire

L = Lay

m = Number of carriers

n = Number of ends per spool

To resolve this difficulty the filling factor should be used for approximate results. The braiding machine can then be set up and the lay adjusted to suit.

4.18. Some useful hints for dealing with mechanical troubles peculiar to maypole type braiders

When a new braiding machine is installed it is essential that the deck is set-up perfectly level and the machine firmly bolted down. Care and attention are needed for the first few months of service especially with regard to cleanliness and lubrication. Like the majority of mechanical appliances of this nature it is beneficial to proceed with caution during the running in period.

Should any faults develop it is extremely important that they are quickly and correctly located and rectified as soon as possible. Incorrect diagnosis of a fault can cause considerable frustration and waste a lot of time.

With so many working parts of a like character to contend with it is quite easy to pick on what appears to be a fault, and when operations are resumed, to find that the trouble has not been eliminated because the real fault has not been detected. Considerable patience and experience are usually needed in trying to assess some of the obscure difficulties that are often encountered when dealing with braiding machines. Some typical mechanical faults and remedies are listed: —

Decks

As a general rule maypole braider decks are of necessity constructed in such a manner that it is inadvisable to dismantle them unless absolutely compelled to by virtue of circumstances. Whether large or small, if ever a deck has to be stripped it is sound policy to make sure that every item is marked or numbered as it is taken apart, thereby ensuring that all parts

can be re-assembled in their original positions. Even when these precautions are taken it is not an easy task to re-assemble the deck and avoid tracking errors with any certainty.

A slight tilting or slewing of a quoit plate or a burr on one of the spacers or horngear pins will be quite sufficient to cause a tracking error of enough magnitude to create a tight place in the carrier tracking. Carrier transfer should always take place smoothly and freely and although it is sometimes possible to work a braiding machine with a tight spot in the tracking, errors of this nature should never be neglected because if they are not quickly rectified severe damage will be done to the machine in a short period of time.

As an example let us consider a horngear seizure, which fortunately is a rare occurrence. The first and most essential step to take is to try and ease the tight bearing sufficiently to be turned for the purpose of carrier extraction. Sometimes the affected gear can be moved after flooding the bearing with paraffin or easing oil and leaving to soak for about half an hour. It may then become possible to bar or prise the gear train round until all the carriers have been removed. If this can be done, it is a comparatively simple matter to remove the faulty horngear, clean up and re-assemble. Failure to extract the carriers will mean that the whole machine has to be stripped right down to the base plate. The whole top structure must be dismantled and all the track plate and spacer nuts removed.

Track plates and quoits with the carriers still in place must then be carefully and evenly prised up, and when once the plates and quoits are clear of the studs the whole deck literally falls to pieces, enabling the seized horngear to be removed for rectification. This procedure demands great patience, especially if the machine is a large one with many carriers.

Due mainly to the constant vibration and chatter set up when maypole machines are working, breakages sometimes occur after prolonged use, and this phenomena which frequently puzzles maintenance personnel is generally due to crystallization or work hardening effects on the metal caused by the prolonged chatter associated with carrier movement. It is policy therefore to keep braiders in an efficient and smoothly running condition at all times and thereby reduce the risk of breakages to a reasonable minimum.

Normally the material used for track plates is high grade close grained cast iron and given reasonable treatment the use of this material will ensure that the machine will have a very long working life.

When after long and continual use, these plates do become badly worn

it is usually better to renew the complete tracking and horn gears rather than attempt repairs by welding.

Braiders manufactured by Textile Machine Works U.S.A. are, however, generally equipped with track plates made of high carbon steel. These plates also have a long working life with the additional advantage that this working life can frequently be extended.

Track plate wear is usually most marked at the tracking inter-sections and when the points on star or outer plates of steel become badly worn, these points can be cut off and new metal can be welded to the track plates and blended. When track plates have been repaired or even when a new set has been fitted a simple test should be made for errors in track alignment. This trial should be made preferably in a quiet period when other machines are shut down. Two carriers should be inserted in the machine, one in each track, first making sure that they are correctly related. Turn the machine slowly by hand and note carefully if either of the carriers shows any tendency to heel over slightly or pull hard at any particular place in the tracking. Run the machine during a quiet period for about ten minutes when any irregularities will be easily heard. Remove the carriers and examine the tracking carefully. High spots or tight places will be visible as bright marks on the metal and these high spots should be removed by filing or scraping. Carriers should be re-inserted and another short trial run made. This process should be repeated until the two carriers run smoothly round the tracking. The full complement of carriers can then be inserted and the braider made ready for service.

Cut-out or trip levers

Adjustments to trip levers should always be made with great care and once they are set, should be firmly secured in position to discourage any tampering by irresponsible operators. With the older types of braider, mechanically operated trip levers are usual and if for any reason this mechanism becomes stiff or sluggish in action there is a serious risk of inferior braid production.

Change gears

Two styles of change gear are in general use: —

1. Fixed centres — a system whereby the rate of feed is varied by using gears, each pair of which have the same total overall number of teeth e.g. if the total number of teeth in a pair of correctly meshed gears = 150 then the feed rate can be varied by pairing 50 : 100 — 75 : 75 or 25 : 125 and so on. This simplifies gear changing but imposes definite limits on the overall range of ratios.

2. Adjustable centres – adjustment for correct meshing in this system is made by using either a quadrant or a sliding gear bracket. This system gives a greater overall range of ratios but there is an attendant risk that careless or inexperienced operators will set the gears too slack or too tightly in mesh and thus create a tendency for an erratic feed.

With the majority of small braiders the change gears are secured to the shafts by means of set screws in the gear bosses. Normally these gear shafts have flats milled on the shaft ends for location purposes, but careless or indifferent operators have been known to tighten up the gear-boss set screws anywhere on the shaft ends except on the flats. This procedure results in a badly scored shaft and makes gear changing difficult.

Braiding guides or formers

A certain amount of experimenting is usually necessary when setting the braiding guide or former in position. For average tubular braiding work the die or guide should be set centrally and slightly below the natural braid formation point which varies according to the diameter of the product and the rate of feed. With flat braids positioning usually needs careful adjustment and with some of the fancy braids is really critical.

Carriers

Although carriers vary considerably in design the functioning is the same in all cases – to pay out yarn or wire as required, to stop the machine in the event of broken yarns, wires or empty spools and by virtue of carrier motion to form the braid. Carriers should be lubricated with the utmost discretion and all working parts must function smoothly and freely. Correct tensioning is important and spools of material must be properly mounted. With so many carriers in a machine, sometimes there are ninety six or more, it becomes a difficult task to trace a fault. If a braiding machine stops frequently with broken yarns or wires, the braider should be kept working for a time and whenever a yarn or wire breaks the affected carrier should be marked in some way. Normally the trouble will be confined to one particular carrier and when this is located all working parts should be carefully examined. If found in good working order the trouble can be caused by a poorly wound or badly mounted spool of material. If yarns are being braided the copholder should be examined for damage or wear and if faulty should be replaced. The carrier dropper should fall freely under gravity on the tension post and thread

guides should be examined closely for wear. Certain types of yarn such as rayon are notorious for cutting grooves in thread guides and if for example a change is made from rayon to ordinary cotton it may be found necessary to renew all the thread guides.

Weak or damaged tension springs should also be replaced. It is not uncommon practice for servicing personnel to remove foul or dirty carriers from a braider and wash them in a bath of paraffin. This is definitely bad practice and should be promptly discouraged. A thin light machine oil is best used for this purpose and this also has the advantage that after surplus oil has been removed the carrier is lubricated and ready for service. Obscure faults do occur from time to time and these are best dealt with by the rather tedious process of trial and elimination. Obvious faults should be rectified as they are seen and eventually the real cause of trouble can be traced.

Safety devices (mechanical)

The majority of modern braiders are equipped with some form of safety device to guard against overloads or similar mishaps. For small or medium sized machines this usually takes the form of a simple safety or shear pin. Shear pins must be readily accessible, easy to replace and the material used is sometimes steel but more frequently it is phosphor bronze. Shear pins are usually to be found in the driving mechanism of the braider, a common and simple method consists of a standard taper pin of suitable proportions fitted through the hub of the driving pulley and shaft. In the event of a sudden or heavy load the pin shears and the driving pulley is free to rotate on the driving shaft. To give an example of the necessity of these overload devices: — A length of wire or cable is being processed and at the conclusion of the run the cable is pulled clear of the let-off drum. If attention is not given to this end as it passes up through the braiding machine there is a danger that when the loose end reaches deck level the freed cable or wire will curl up and become entangled in the carriers. A mishap like this can cause several carriers to be broken if there is no overload device.

Flaking or traverse gears (wires and cables)

Flaking or traverse gears provide the means whereby the finished braided product is guided and sometimes uniformly wrapped on to the reception reel or drum. Many ingenious traversing gears are to be found in general use some fixed, some variable and each style of gear seems to have vices or virtues. When batteries of small braiders are in use as is common in the cable industry it is debatable whether the complication of a unit

mechanical traverse is worth while. A number of firms seem to prefer the use of a suitably located fixed comb or guide at the outlet side of each small braider and to rely upon the operator to make sure that the reception reels are loaded in a reasonable manner. Braiding being a comparatively slow process this procedure seems to work quite well.

A neat example of auto-traverse is to be seen in Fig. 17 (Page 24). This is a spring loaded cam operated gear on a braiding machine built by B. & F. Carter (England). The cam is gear driven by the take-up sheave and an oscillating motion is imparted to the curved lever situated at the top of the side frame. In turn this lever pushes the traverse or guide rod slowly backwards and forwards. An adjustable guide is attached to the traverse bar to ensure that the braided product is wrapped uniformly on the reception reel situated above and at the rear of the take-up sheave. Many processes in the cable and wire industry depend upon a uniform rate of feed for successful results and quite a number of cases of defective processing can be traced to badly wound reels. Most modern braiding machines are equipped with efficient traversing gear but even so if the let-off or supply reel is badly wound or out of balance any of these defects can result in poor quality or erratic braid. A simple form of mechanical traverse sometimes found on medium sized or heavy braiders consists of a fixed shaft mounted on brackets attached to the top of the reception reel stand. A right and left hand square section spiral groove is cut in the shaft and these two grooves which intersect at regular intervals are cut to suit the desired length of traverse. At the extremities the two tracks meet and are suitably blended. Rotating on the shaft is a guide pulley suitably shaped to accomodate various sizes of cable. An extended boss or hub on one side of the pulley contains a swivelling thread follower or boat which is inserted in the grooves on the shaft. See Fig. 88. The

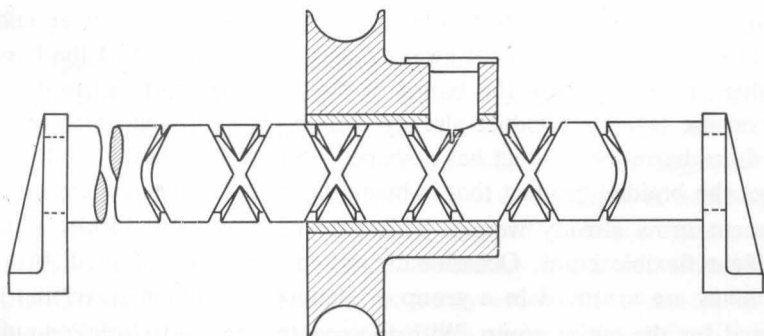


Fig. 88. Self Traversing Pulley

braided product is pulled over the pulley by the slowly rotating reception drum. This action causes the pulley to turn slowly and as it does so, the thread follower in the hub forces the pulley to slide gradually along the shaft in each direction in turn. Although simple in character there are some disadvantages associated with this type of traverse. Care is needed when assembling this type of traverse gear and when in use heavy pressure is exerted upon the track follower or boat as it is sometimes called. After prolonged use, either the thread grooves or the track follower becomes worn and there is a marked tendency for the traversing carriage to become locked at one or more of the intersections or crossings. The main disadvantage with this gear is that a coarse traversing pitch is generally used and this cannot be varied to suit the many sizes of cable. A useful and more frequently encountered arrangement for cable traversing gear is the set-up whereby the guide pulley or forks are attached to a housing mounted on guide bars which are arranged parallel to the traverse screw. The screw is rotated by means of an adjustable ratchet and pawl system and variations to the rate of traverse are made simply by altering the stroke of the ratchet pawl. Adjustments which can be made when the unit is working are simply carried out by altering the stroke of a variable crank or quadrant. This style of traverse gear is usually driven by the reception drum, driving gear. Thus the traverse screw is turned part of a revolution for each complete revolution of the reception reel and lateral movement at the correct rate of travel is imparted to the guide pulley or forks. A reversing gear completes this type of mechanism which has the great advantage that slight alterations are readily made to suit the many different sizes of braided product. Another very simple traversing arrangement suitable for light work is the stylus or guide tube. This usually takes the form of a plain tube one end of which is attached to the braiding machine via the medium of a spring loaded universal or flexible joint or coupling. The other end of the tube, part of which is cut away to permit the insertion of the braided product, rests either on the barrel of the reception reel or, as this fills up, on the layer of product already wound. The tube end that rests on the drum barrel or product has a shaped fin at the extremity, and this fin keeps the braided product that is being drawn on to the reel close to the adjacent turns already wound. This type of traverse is ideally suitable for light flexible cores. Occasionally, when a number of small braiding machines are arranged in a group or battery a common traversing gear is used for the entire group. With this system the guide forks or pulleys are attached in suitable positions to one long bar or tube and this tube

which is free to move backwards or forwards is arranged in guide frames at the back or outlet side of the machines. Movement of this bar is controlled by a single driving unit situated at one end of the table. The disadvantage associated with this method is that the traverse continues to function irrespective of how many braiders are working or how many are stopped.

4.19. **Hints for dealing with certain mechanical problems peculiar to the “Wardwellian” rapid braider**

Like all braiders, correct servicing, cleanliness and regular attention to lubrication will ensure that mechanical failures are extremely rare. Problems do sometimes arise however and if the user is unfamiliar with the machine difficulties are created.

Clutches

Metal to metal spring loaded cone clutches are standard on all “Wardwellian” braiders. Correctly adjusted this type of clutch is comparatively troublefree and under normal conditions of service will last as long as the machine. Occasionally however a clutch will develop a fault that is sometimes puzzling. The symptoms are that the clutch emits a harsh screeching sound when engaged and the usual feeling of correct entry is absent. Six compression springs are used to hold the clutch faces in firm contact for driving. After prolonged service the end of one or more of these springs sometimes becomes distorted and turned over. This distortion permits the clutch faces to mate but under these conditions slip will occur especially with a starting load. A clutch in this condition should be dismantled and if any of the springs are found to be weakened or distorted the whole set should be renewed.

Slipping drives (take-ups)

When slipping clutches are used for driving the reception reel or drum, it is essential that the clutch should be adjusted so that a firm even tension is maintained on the product and that the reel or drum should rotate smoothly and evenly. If these clutches are maladjusted or neglected the result will be inferior braiding. If after careful attempts at adjustment the clutch behaves erratically it should be stripped down for examination. Sometimes cleaning will be all that is necessary but if on examination the clutch plate faces are found to be badly scored the plate should be renewed. Some machines are equipped with slipping belt drives instead of clutches and belts used for replacement should be chosen with care.

Endless belts are to be preferred and bulky metal fasteners should on no account be used because erratic slipping will occur each time the fastener rides over the pulleys thus creating a tendency for erratic braiding. When fragile cores are being braided the tension on the core is difficult to regulate. In cases like this double slipping should be used. To do this the driving dog on the drum or reel spindle should be removed. A leather or rubber disc of suitable proportions should be slipped on to the drum spindle and secured in position firmly against the hub of the take-up reel by means of a suitable collar. With this arrangement the clutch and the take-up reel are both under controlled slip and if carefully adjusted it is possible to wind-up extremely frail cores without difficulty.

Upper carriers

Under normal working conditions it is seldom necessary to renew upper carriers, but due to accidental damage or excessive wear in the carrier driver bar slots an occasional replacement may be needed. The driver bar slots usually fail either through the use of poor quality lubricant or neglect to observe the daily ritual of regular oiling. Upper carrier replacements should always be made with care, otherwise there is a danger that a new carrier will have a very short working life. When a replacement is needed it will firstly be necessary to remove all upper carriers, driver plate cover and driver plate. The new carrier, minus all parts and numbered on the nose to coincide with the damaged carrier should be inserted in the track plate carrier race and swung backwards and forwards by hand. Take particular notice whether or not any knocks can be felt as the carrier passes from section to section. Continue moving the carrier round the track until the keel is marked, and this marking will indicate if and where the carrier is bearing hard. The carrier should then be removed and filed lightly with a smooth file only where marked. This process should be continued until the carrier moves freely from section to section without any signs of knocking. The carrier is now ready for the driver bars to be fitted and this should be carefully carried out as follows: —

1. Line up the zero timing marks, replace the driver plate and fasten this securely in position. Observe the number stamped on the scalloped section of the driver plate in which the new carrier will function.
2. Insert the driver bar belonging to the section in the proper slot in the driver plate, upside down in order that the driver bar stud can be taken hold of.

3. Enter the driver on the righthand side into the carrier slot and then exert a slight hand pressure towards the left and try to enter the left hand driver bar. It is possible that this driver will enter, but it is also most likely that a slight knock will be felt. Do this a few times and notice particularly on which side of the slot the driver bar is hitting.
4. Reverse the action; that is enter the left hand driver bar into the carrier slot and remove the right hand driver. Again apply hand pressure but this time towards the right. Now enter the right hand driver, again taking particular notice as to which side of the carrier slot the driver bar is hitting.
5. With an 8" file that has a safe edge, carefully and lightly file the slots in the carrier on the sides that the driver bars were hitting when trying by hand in operations 3 and 4. Note. The filing should be done with extreme care, holding the file perfectly straight and filing lightly.
6. Replace the carrier and repeat operations 3 and 4 to see if sufficient metal has been removed for the carrier drivers, to enter the slots without knocking. If too much metal is removed the drivers will knock on the opposite side of the carrier slots, thus making it necessary to file these sides. Should this occur it must be strongly emphasised that the slots must on no account be made too wide.
7. Any sharp edges on either the carrier slots or the driver bars should be removed with an oil stone.
8. When the drivers have been correctly fitted the carrier should be carefully cleaned and every trace of filings removed. Slots should then be lightly oiled and the new carrier assembled ready for service.

It is important to remember that all upper carriers in service should have the keels systematically and sparingly oiled. Excessive oil here imposes a terrific drag on the machine and in extreme cases the driving belt will quickly overheat or be thrown off on starting. In previous chapters the salient features of the 16 and 24 carrier "Wardwellian" rapid braiders have been described.

In addition to these standard braiders there are some thirty different applications of "Wardwell" equipment which include braiding taping and serving. Some details follow describing the ways in which these braiders can be adapted for certain processes.

Three standard machines are in general use and these are as follows:
12 carrier rapid braider with a maximum speed of 200 R.P.M. suitable

for covering flexible conductors up to $\frac{1}{4}$ " in dia. This machine can be equipped with special attachments for producing shoe thread. This equipment includes a pan for holding solution for saturating the thread, a manipulator for thread immersion and a dryer frame which allows time for the thread to dry before it is wound on to the take-up stand.

16 carrier rapid braider with a maximum speed of 160 R.P.M. suitable for flexible conductors up to $\frac{1}{2}$ " dia. If so desired the machine can be supplied with a special beater opening that will accomodate conductors up to $\frac{11}{16}$ " dia. This braider can be used for wire braiding. Special parts are needed for wire, and recommended speed for this purpose is 75 R.P.M. In addition conversions are possible so that the braider can be adapted for producing Venetian bords. With the aid of a special braid-former and softener attachment it is possible to braid over thin walled tubing or electrical conductors requiring a slack sheath.

24 carrier rapid braider – maximum speed for yarns 110 R.P.M. Maximum speed for wire 55 R.P.M. This type of head can be also supplied for cable braiding-speed for cables up to $\frac{3}{4}$ " dia 100 R.P.M. Over $\frac{3}{4}$ " dia and up to maximum of $1\frac{1}{8}$ " dia carrier speed = 75 R.P.M.

If required any of these machines can be adapted for 1 : 1 braids simply by changing thread deflectors.

Double deck braidiers – These machines for applying two coats of braid simultaneously are available as listed

16 × 16 carriers

16 × 24 carriers

24 × 24 carriers

Full details are available from the makers or from

James Mackie & Sons, Ltd., Belfast, Ireland.

A wide variety of high speed tubular braidiers are also produced in Germany. All these braidiers are designed on the lines of the Guido Horn machines described earlier. The manufacture of these high speed machines seems to be mainly by two firms: – W. & M. Ostermann, Wuppertal-Barmen and Th. Spirka K.G. of Alfeld a. d. Leine. It appears that Th. Spirka specialise in these fast braidiers and models N, G. & F. which are nocker arm deflection machines are available with 8, 12, 16, 24, 32 and 36 carriers.

Braiding is drawn off vertically on machines with 8 to 24 carriers or horizontally on 24 and 36 carrier machines. Subject to running at the designed speed these braidiers can be used for most types of yarn or copper wire copper strips or even steel wire up to 8 ends .015". It is claimed that

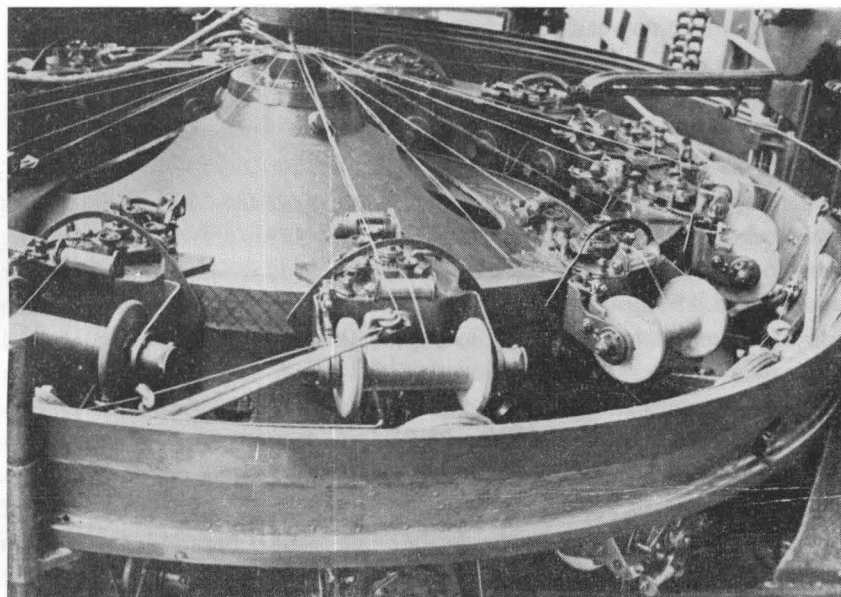


Fig. 89. Type N.G. High Speed Braider (*Th. Spirka K.G., Germany*)

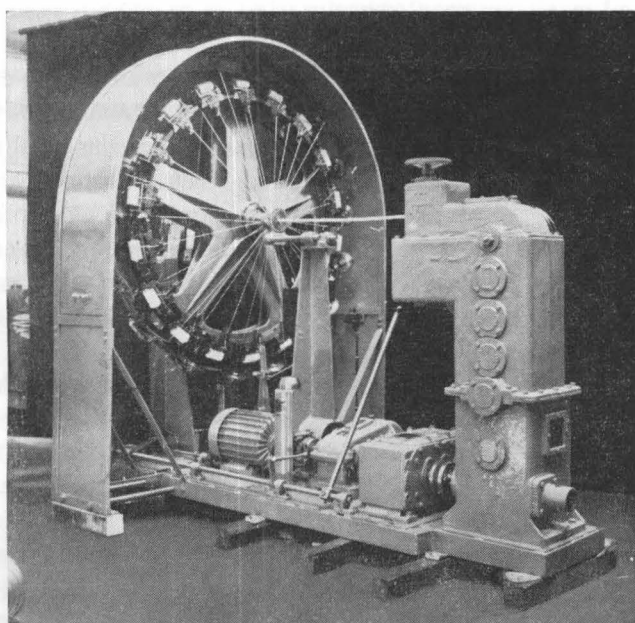


Fig. 90. 36 Carrier Horizontal "Horn" type Braider (*W. & M. Ostermann, Germany*)

up to 15 machines can be operated by one man. Fig. 89 shows a type N.G. machine. Fig. 90 shows a "Horn" type 36 carrier horizontal braider built by W. & M. Ostermann.

4.20 Spool winding for wire braid

It cannot be too strongly emphasised that good firm spool winding is absolutely essential for successful wire braiding. This also applies to many other processes involving the use of wire, such as stranding, bunching or armouring. All too often in the so called interests of production one encounters operators struggling to cope with large numbers of spools and crude winding appliances. Production personnel in particular are often prone to think that it is good practice for a single operator to wind a number of spools simultaneously. Given first class winding equipment this is not impossible but in many factories efficient winding machinery is conspicuous by its absence when braiding is being considered. Waste of both time and material must be considerable, solely because of neglect to pay attention to this very important pre-requisite. Yarns can be obtained from suppliers, wound ready for use with little or no difficulty but where wire is concerned wire for braiding usually has to be wound from bulk supplies sent to the braiding department. In the interests of a uniform pay-out and maximum spool capacity wire for braiding is normally layer wound on to the spools — each wire or group of wires is laid or wrapped so that the turns are side by side, with a uniform and equal tension on each individual wire and this tensioning has to be maintained until the winding of the spool is completed. In actual practice this ideal is seldom realised unless extreme care is exercised when adjusting for traverse reversal. A flat ribbon formation of several wires will tend to cockle or foul at each end of the spool barrel and the slightest jolt or variation in the changeover mechanism will aggravate the situation when winding at high speeds. Even when single wires are being wound there is a risk of trapped turns unless the change-over mechanism is accurately set. It should also be remembered that as the diameter of the winding builds up, the speed at which the wire is drawn from the supply increases with each layer of wire and this in turn tends to create wire fouling at the spool barrel extremities. This cockling or trapping of fine wires at each end of the spool, coupled with the angle at which the wire is drawn from the spool when in position on the braiding carrier can give rise to considerable trouble during braiding operations. Largely depending upon the tensile strength of the wire, in many instances a trapped wire will pull clear during braiding but quite often the sudden jerk as the wire or wires pull

free will be sufficient to cause abreakage. Badly wound or unbalanced let-off or supply reels can play havoc with attempts to maintain uniform tension when braider spools are being wound. Supply reels usually contain a considerable quantity of wire, varying anything from 4 or 5 up to 70 or 80 lbs in weight, depending upon the size and nature of the wire. Also, some form of automatic braking is absolutely necessary for let-off spools because if for any reason the winding gear is stopped the supply reels, due to momentum will overrun and time and patience will be needed to sort out loose turns and foul wire before winding can recommence. Ideally both braider and let-off spools should be strongly and accurately constructed, light in weight and most important of all true running. The braider spools should also have at least one small starting hole in each flange close to the periphery of the barrel. This will allow the wire to be pushed through the flange from the inside and secured on the outside thus avoiding the necessity of tying untidy knots or turns on the barrel of the spool when securing the end for starting.

Most modern winding gears are designed for smooth gentle starting and this is usually achieved with the aid of some form of fluid drive or else a rheostat is incorporated in the motor control. This is a very necessary feature because to start up at full winding speed would certainly mean an uneven winding or foul or broken wires.

4.21. Some recent developments connected with hose making and cable covering

Modern production tends to organise manufacturing plant to combine as many processes as possible in a single operation. In this manner handling costs and problems are reduced and the hazard of faults or damage when the product is transferred from one proces to another is virtually eliminated.

Certain processes in hose making and cable covering are in many respects similar: – braiding, knitting, wrapping, serving or taping. These processes are familiar in both industries and generally speaking are used for similar purposes, i.e. reinforcement or protection. Whereas the function of sheaths so produced is mainly for protection in cables, for hoses the primary function is reinforcement for resistance to bursting although with some types of hose an armoured sheath is provided for protection as well as strength.

For some years now knitting has been used for certain types of wire and cable covering and also for many types of low and medium pressure hoses. A lot of pioneer development work in connection with machines

for this work has taken place in U.S.A. The firm responsible these interesting developments is Singer Fidelity Inc. and with many years of both braiding and knitting experience behind them they have recently introduced a novel and useful machine for hose reinforcement.

The wrap-knit machine as the title suggests is a dual purpose arrangement combining the functions of wrapping and knitting yarns for the purpose of hose re-inforcement. With the use of this up-to-date equipment it is claimed, winding costs are eliminated and a considerable saving in yarn is effected without in any way affecting the burst resistance. This new machine seems to be ideal for reinforcing low and medium pressure hoses. Fig. 91 shows a single decker machine. Double decker machines

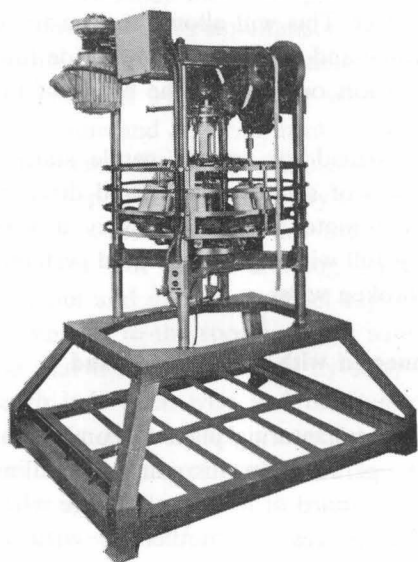


Fig. 91. "Sinfra" Wrap Knit Machine
(Singer-Fidelity Machine Co., U.S.A.)

are also available and this type of machine will apply two fabrics to the tubing with a rubber strip in between them. When considering hoses the size is the bore or inside diameter of the finished tube. Several operations are usually needed to manufacture a complete hose. Size, type, working pressure, nature of service, all these have to be carefully considered. Depending upon specification an inner tube is extruded first and this can be either of plastic or uncured rubber. A reinforcing sheath is then put on and this can be knitted, braided or wrapped. After this the reinforced tube is again passed through a covering machine which adds another layer of plastic or uncured rubber. In the case of a rubber hose this is now vulcanised or cured and one method used is to lead cover the hose

and put it into a curing vessel for the necessary curing time. The function of the lead sheath is to preserve the good shape of the hose during the curing process. When the hose is of plastic the final sheath is put on by passing it again through an extruder thus completing the hose.

With small diameter hoses the uncured rubber retains shape well enough for the knitting process to proceed even though there may be a tendency for the tube to flatten. On larger hoses, low pressure air is used to keep the tube in an inflated condition during the reinforcing. Air pressures although low, must be carefully controlled, because over inflation will tend to distort the tube. A feature of the "Sinfra" knitting machine is that standard heads are available to suit a particular range of sizes.

When the knitted fabric is put on the tubing it is of great importance that yarn tensions are maintained to ensure that the fabric is firmly wrapped on the tube with a uniformity of stitching. This tensioning can be effective on various sizes of tubing only to a limited extent. If too large a head is used there is a tendency for the knitted sheath to become loose. Variations in the pattern of the knitted fabric are possible by re-arranging the needles or altering the change gears. All types of yarn can be worked on these machines but by far the most commonly used yarn for hose work is rayon. As can be seen in Fig. 91 the cones of yarn used are standard to the textile industry and by using these cones a considerable saving is effected because rewinding is rendered unnecessary. Fig. 92 shows two excellent examples of the work done on these machines. Reinforcing can be effected by using almost any suitable yarns. The

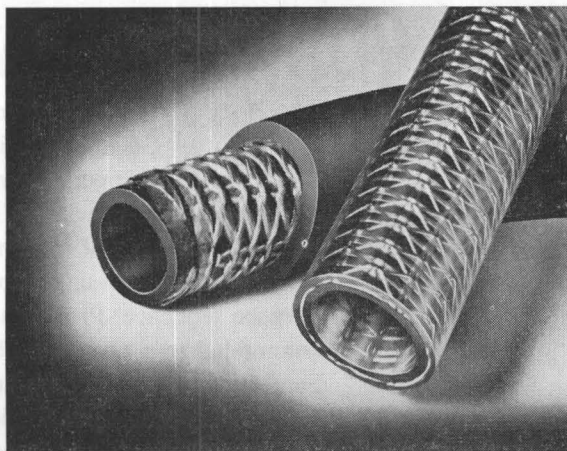


Fig. 92. Specimens of "Wrap Knit" Hose Work (*Singer Fidelity Machine Co., U.S.A.*)

manufacture of hoses is a complicated and varied business requiring considerable know how, and reinforcement can be effected by using yarns or wire or sometimes both. Braiding, knitting or lapping are the three main methods used both for reinforcement or protection. A new and recently developed machine designed for processing hoses or rigid tubes is seen in Fig. 93. This is a single rotor 160 Bobbin "Pre-Spirohose" tube

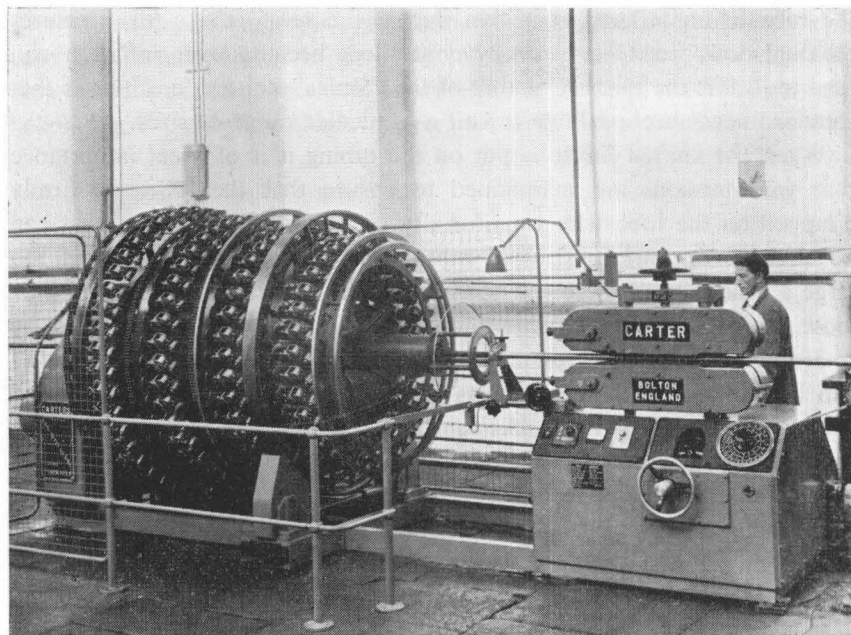


Fig. 93. Pre-Spirohose Tube Making Machine (*B. & F. Carter, Bolton, England*)

making machine designed and built by B. & F. Carter of Bolton England. The machine is arranged for the spiral reinforcement of flexible or rigid tubes with high tenside steel wires so that the properties or conditions of the wires are not changed by processing. Each wire is individually detorsioned so that once wrapped round the tube it will remain in position without the normal tendency to re-assert itself. The single rotor consists of four discs in a 46, 42, 38 and 34 wire sequence. Provision is made at the outlet end of the rotor for accommodating a pad of rubber tape up to 12" dia $\times$ 7½" wide. A 2½" diameter bore, static tube supported in needle bearings passes through the main tube obviating friction between the rotating cage and the hose passing through. Three interchangeable static tubes 1", 1½" and 2" bore are provided. An automatic low voltage

electric knock-off is fitted at the wrapping point consisting of a plated metal ring and designed to operate an electro-pneumatic brake should a wire make contact. Bobbin cradles are fitted with wire tensioning capstans and adjustable friction brakes. An automatic locking device is featured in the design thus ensuring that the bobbin is secure at all speeds. A friction drive between the sprocket and cradles permits easy loading of bobbins. The cradles are designed to operate at from 1 to $1\frac{1}{2}$ back twist per revolution of the rotor. A caterpillar and a 60'-0" chain conveyor haul-off driven from the backshaft through a three speed gear box and a P.I.V. unit completes the arrangement. The caterpillar which is of B. & F. Carter design is equipped with manually operated selfcentering jaws controlled by a handwheel with adjustable pressure control. 0.012" to 0.022" high tensile steel

Wire Range	— 0.012" to 0.022" high tensile steel
Lays	— $\frac{1}{2}$ " to 5"
Motor	— 20 Horsepower
Rotor Speed	— 90 R.P.M. maximum in either direction
Tube Range	— 2" — 0. D. or Overall Diameter maximum.

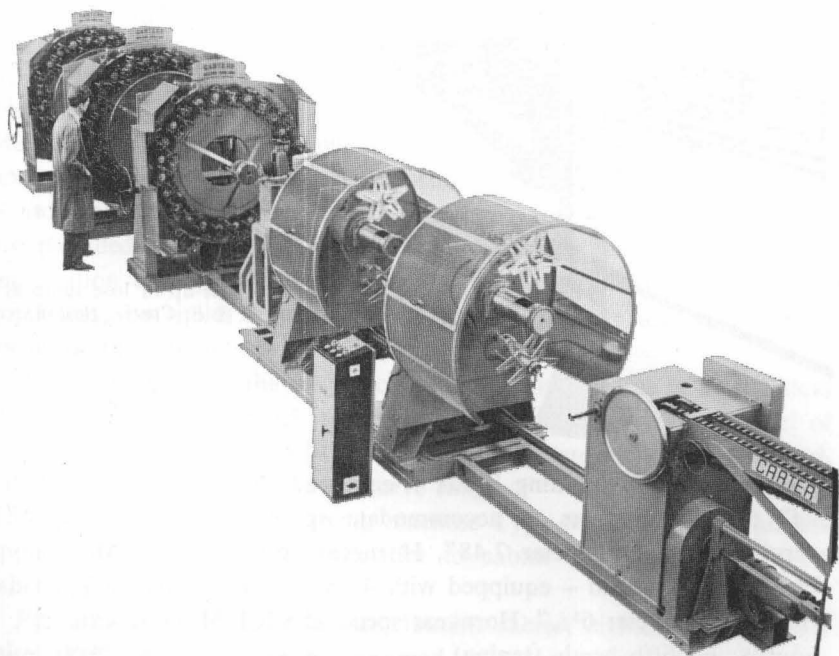


Fig. 94. Hose Braiding Equipment (B. & F. Carter, Bolton, England)

Modern production techniques tend to combine as many processes as possible in a single operation. Time is saved and the ever present risk of damage occurring when the product is, as is often the case, transferred several times for processing. Extra time and care may be needed when setting up for combined operations but advantages are many and usually well worth while.

An example of these modern trends with hose making equipment is seen in Fig. 94. This unit consists of three braiding heads two for wire and one for yarn, and in the front of the braiding decks are two taping heads, thus enabling all operations up to the actual vulcanising of the tube to be carried out in a single process. Between each head or deck is a motorised compound tank for applying rubber solution and the braiding section is followed by the two lapping or taping heads for applying tape or vulcanising cloth. Designed and built by B. & F. Carter of Bolton, this equipment will operate on a wide range of diameters and the 60 ft. conveyor chain haul-off motion is equipped with a motorised device, for raising or lowering in order to maintain the centre line of the tube correctly related to the machine.

Details of the unit are as follows: —



Fig. 95. Close-up of loose removal gear (B. & F. Carter, Bolton)

First and second braiding heads — equipped with 48 mark 6 "High Load" carriers. Carriers to accommodate spools 3" diameter by 6" traverse, Horngear diameter 7.48", Horngear speed 125 R.P.M.

Third braiding head — equipped with 48 yarn carriers.

Horngear diameter $6\frac{3}{8}$ ". Horngear speed 153 R.P.M.

Fourth and fifth heads (taping).

Taping heads to apply two tapes of rubber from pads 14" diameter

× 4" wide. Forward and reverse P.I.V. gear for drive. Haul-off designed to accommodate mandrels up to 67 feet long. Finished hose mandrels can be removed sideways from the conveyor chain by means of three air operated rams coupled to a single control. Separate console contains electrical controls to all heads. Close up view of air operated ram is shown in Fig. 95. A novel departure from the orthodox is seen in

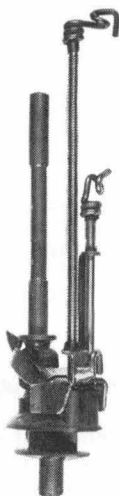


Fig. 96. Japanese Nylon-Steel Carrier

Fig. 96, this time from Japan. This is a reinforced moulded nylon braiding machine carrier. Approximately one third of the weight of the normal metal carrier of similar proportions, a steel rod sheathed in nylon is used for the spool pillar and the tension posts although conventional are moulded into the base. At present there is apparently little or no information concerning the working life of these carriers under service conditions, but quiet running and resistance to wear are indicated by virtue of the design.

A French braider is the subject of Fig. 97. This machine in an excellent example of modern French practice and is produced by E. Brondel of Lyon. The unusual nature of the horn gears has been previously described.

Finally a newcomer to the extensive range of "Wardwellian" machines. This is an Armour Wire Serving machine Type M-E. Designed for the application of multiple end flat wire to cables this machine also has other applications.

For armouring underground distribution cables, eighteen ends of flat wire .008" × .047" can be wrapped at the rate of 250 inches per minute. The eighteen spools are of ample proportions, each one will

accommodate ten pounds of $.009'' \times .047''$ wire. Fig. 98 shows a sample of the finished product.

New design of pay-off and take-up stands are available for use with this machine. These stands which are operated hydraulically and in the case of the take-up equipped with variable traverse gear can take a maximum load of 5000 lbs.

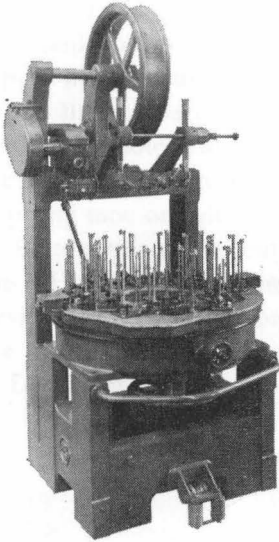


Fig. 97. Modern French Braider (*E. Brondel, France*)

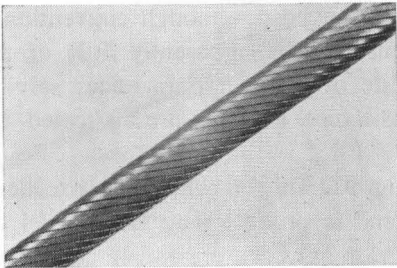


Fig. 98. "Wardwellian" Flat Wire Armour
(*Wardwell Braiding Machine Company,
U.S.A.*)

REFERENCES

Braiders

- | | | |
|-----------------------------------|--------------------|---------|
| (1) New England Butt Co. | Providence R.I. | U.S.A. |
| (2) Mossberg Pressed Steel Corp. | Attleboro. Mass. | U.S.A. |
| (3) Textile Machine Works | Reading Pa. | U.S.A. |
| (4) Singer-Fidelity Mc Co Inc. | Philadelphia Pa. | U.S.A. |
| (5) Wardwell Braiding Machine Co. | Central Falls R.I. | U.S.A. |
| (6) W. & M. Ostermann | Wuppertal-Barmen | Germany |
| (7) Johann Fries | Wuppertal-Barmen | Germany |
| (8) August Herzog | Oldenburg | Germany |
| (9) Froitzheim & Rudert | Berlin-Weissensee | Germany |
| (10) Th. Spirka K.G. | Alfeld-Leine | Germany |
| (11) E. Brondel | Lyon | France |
| (12) B. & F. Carter | Bolton-Lancs. | England |
| (13) J. B. Hyde | Manchester | England |
| (14) Hobourn Aero Components Ltd. | Rochester | England |
| (15) P. Hodges & Co. Ltd. | Nottingham | England |
| (16) Federico Dick | Monza | Italy |

Winders

- | | | |
|--------------------------------|------------------|---------|
| (1) James Day (Machinery) Ltd. | London | England |
| (2) W. & M. Ostermann | Wuppertal-Barmen | Germany |
| (3) Willy Aumann K.G. | Loehne Westf.) | Germany |

- U**
Unbalanced Reels 70
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